APPENDIX B

CCOW MESSAGE FORMATS

B.1 SCOPE

This appendix is a mandatory part of this standard. The information contained herein is intended for compliance. Each CCOW message is defined by bits within bytes. Where a portion of the available bits are not used, the bits are noted by shading. There is one exception. The unique fields in the CCOW:Channel Control Handover Request message are shaded but are to be used. These fields will be defined in MIL-STD-188-185. Terminals operating in the AC mode shall be capable of receiving and interpreting each of the CCOW messages as defined in 5.2.1.1 and this Appendix. Terminals operating in the DC mode shall be capable of receiving and interpreting each of the CCOW messages as defined in 5.2.2.1 and this Appendix.

B.2 CONTENTS

This appendix contains CCOW messages as follows:

CCOW Message **PAGE**

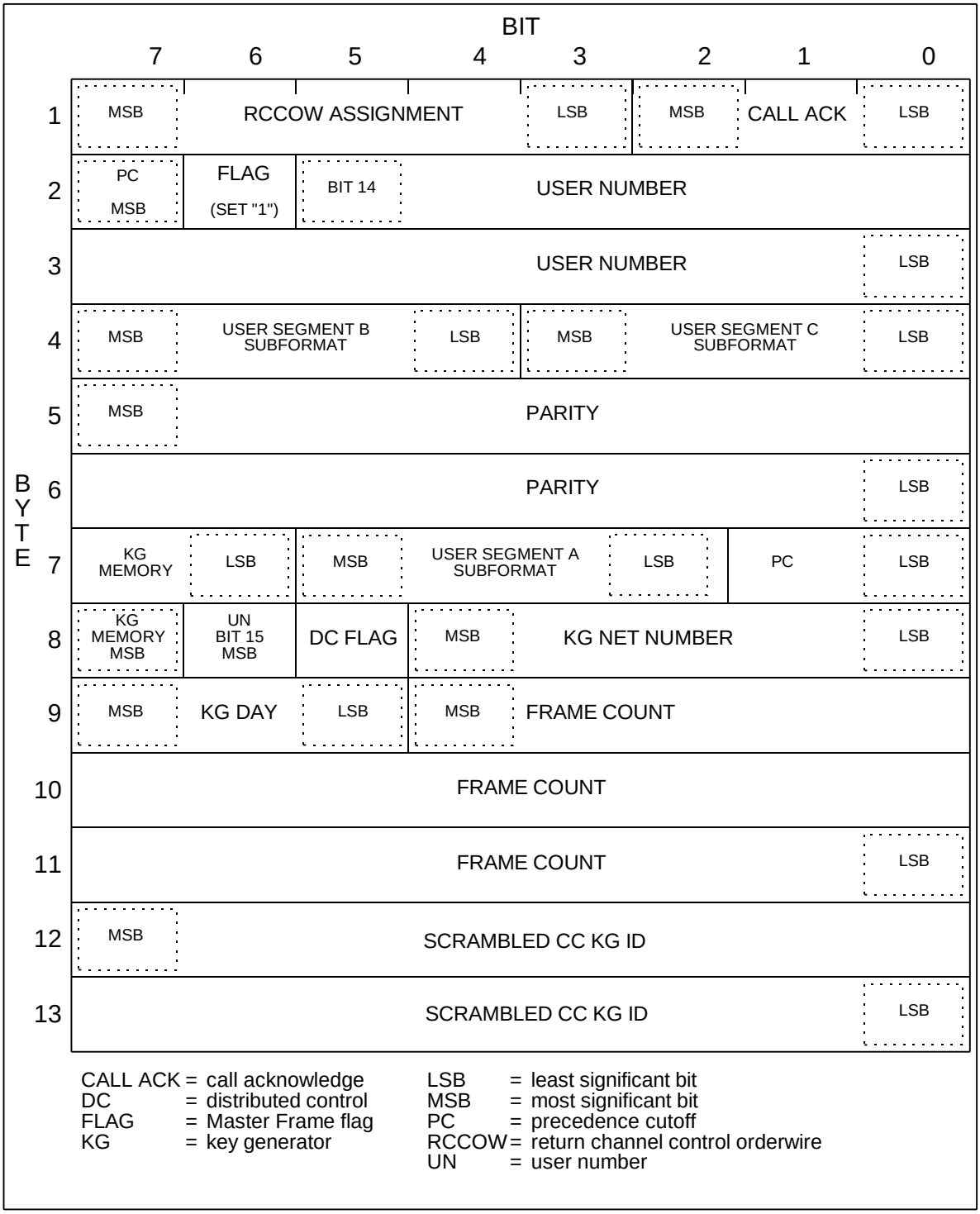

FIGURE B-1. CCOW:Master Frame.

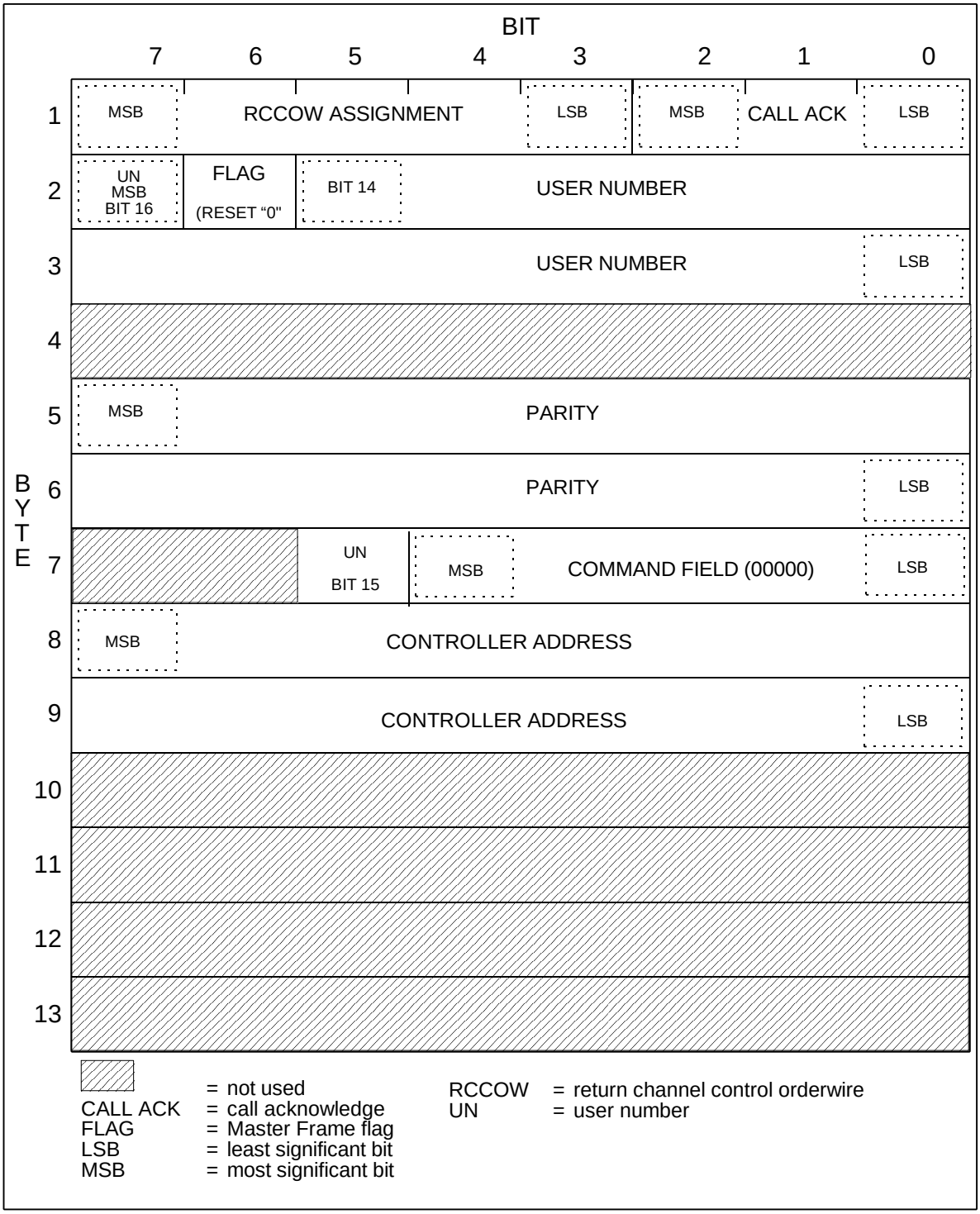

FIGURE B-2. CCOW:No Command.

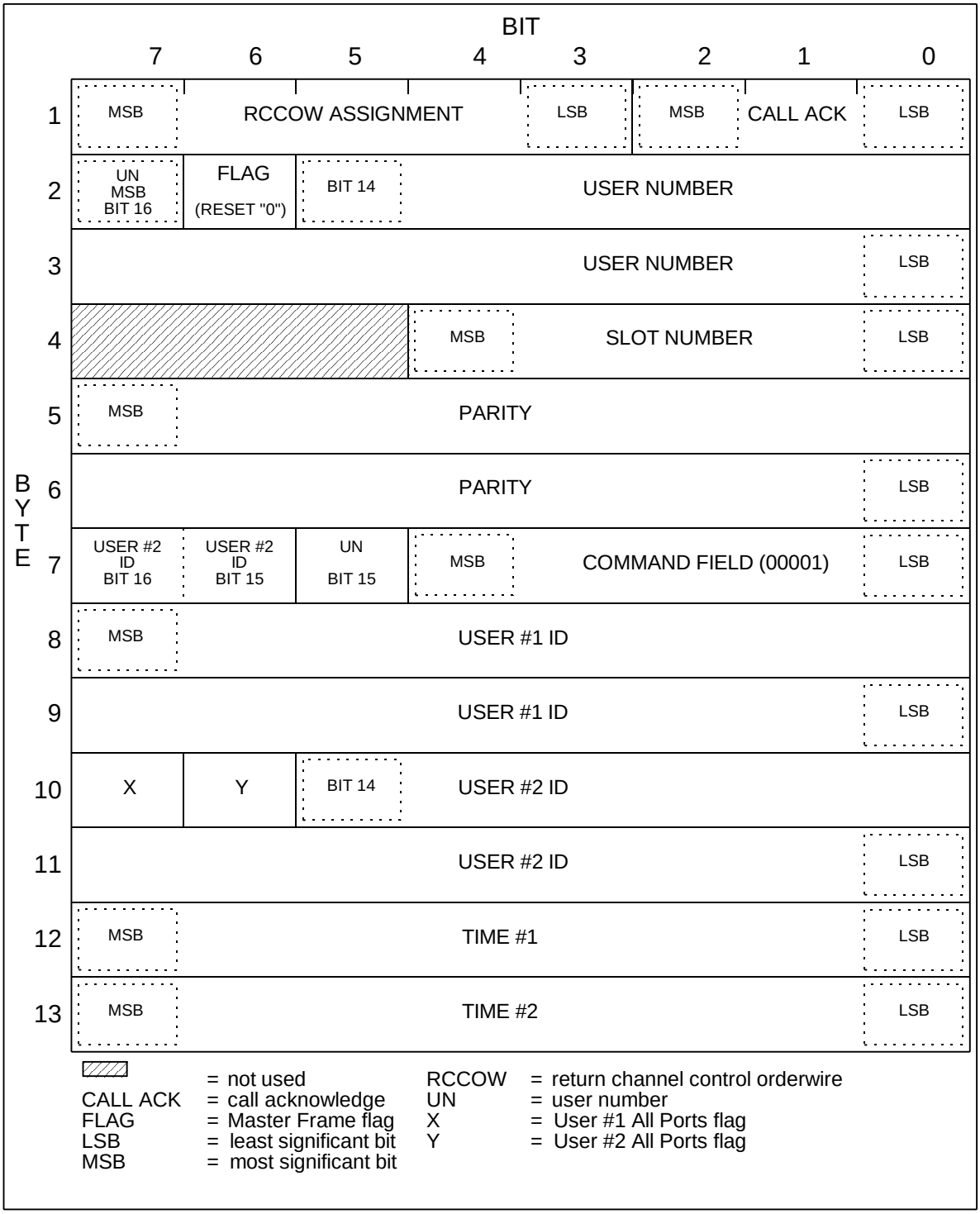

FIGURE B-3. CCOW:Slot Disconnect.

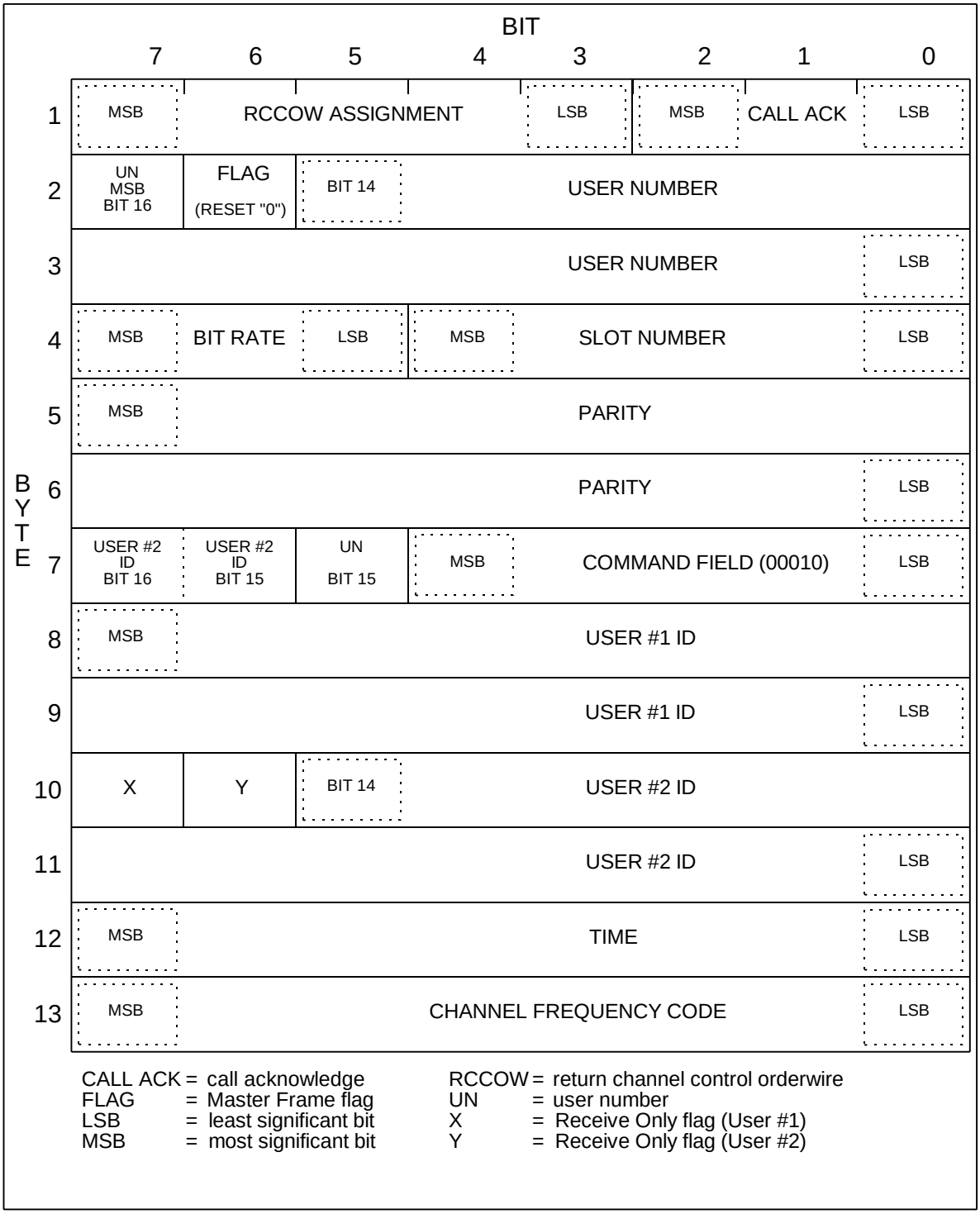

FIGURE B-4. CCOW:Slot Connect.

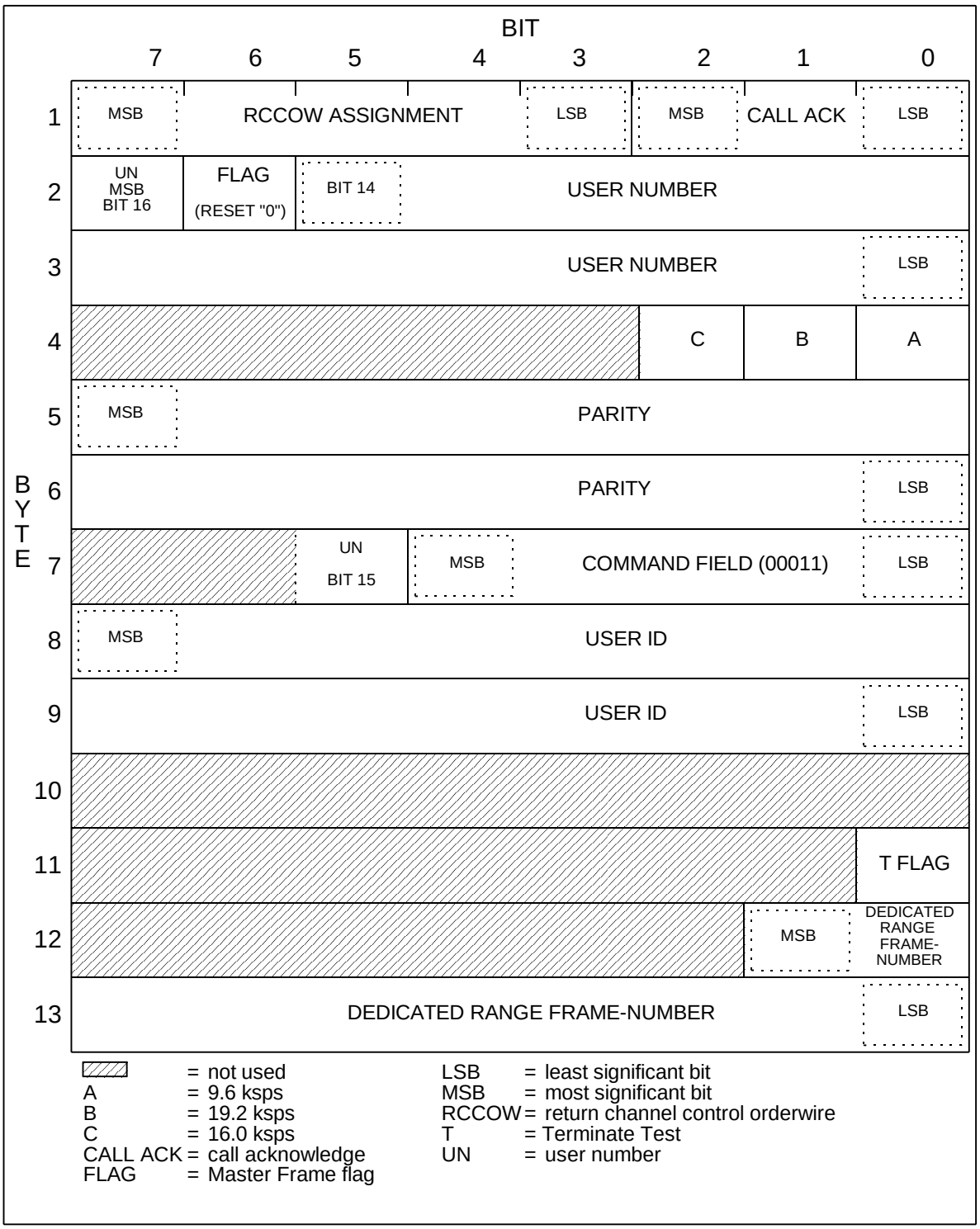

FIGURE B-5. CCOW:Link Test and Range Frame-Number Assignment.

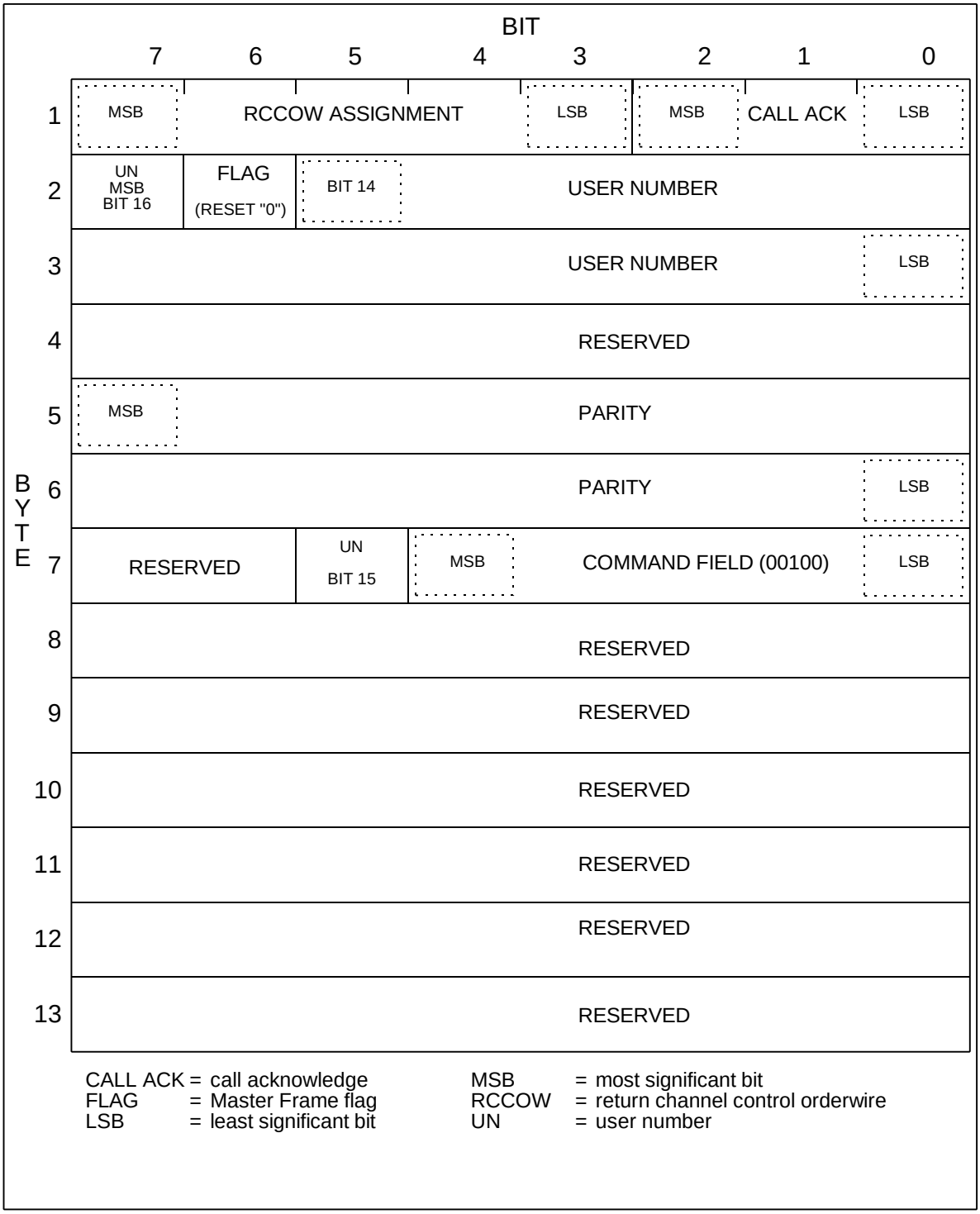

FIGURE B-6. CCOW:Channel Control Handover Request.

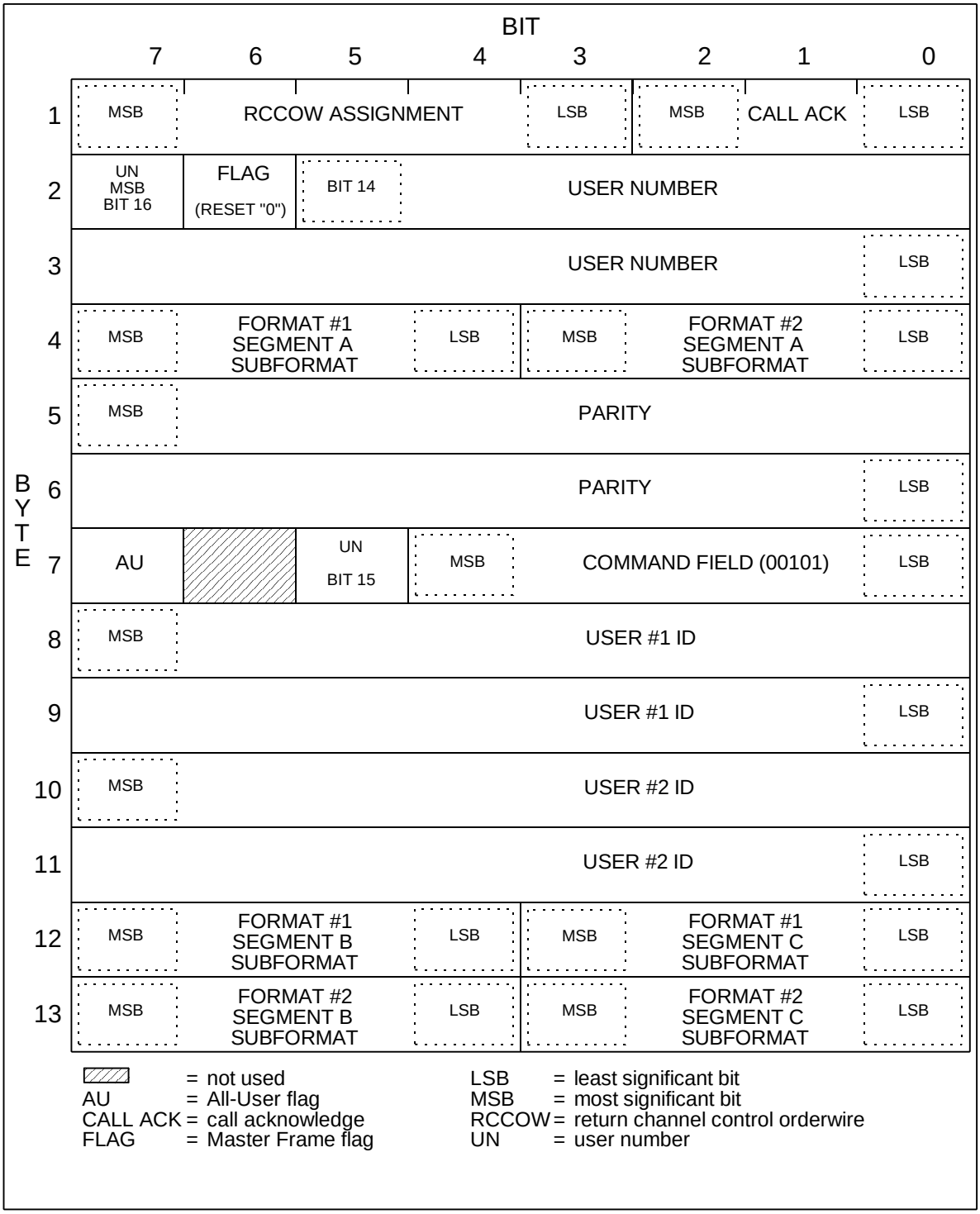

FIGURE B-7. CCOW:Special Format Change Order.

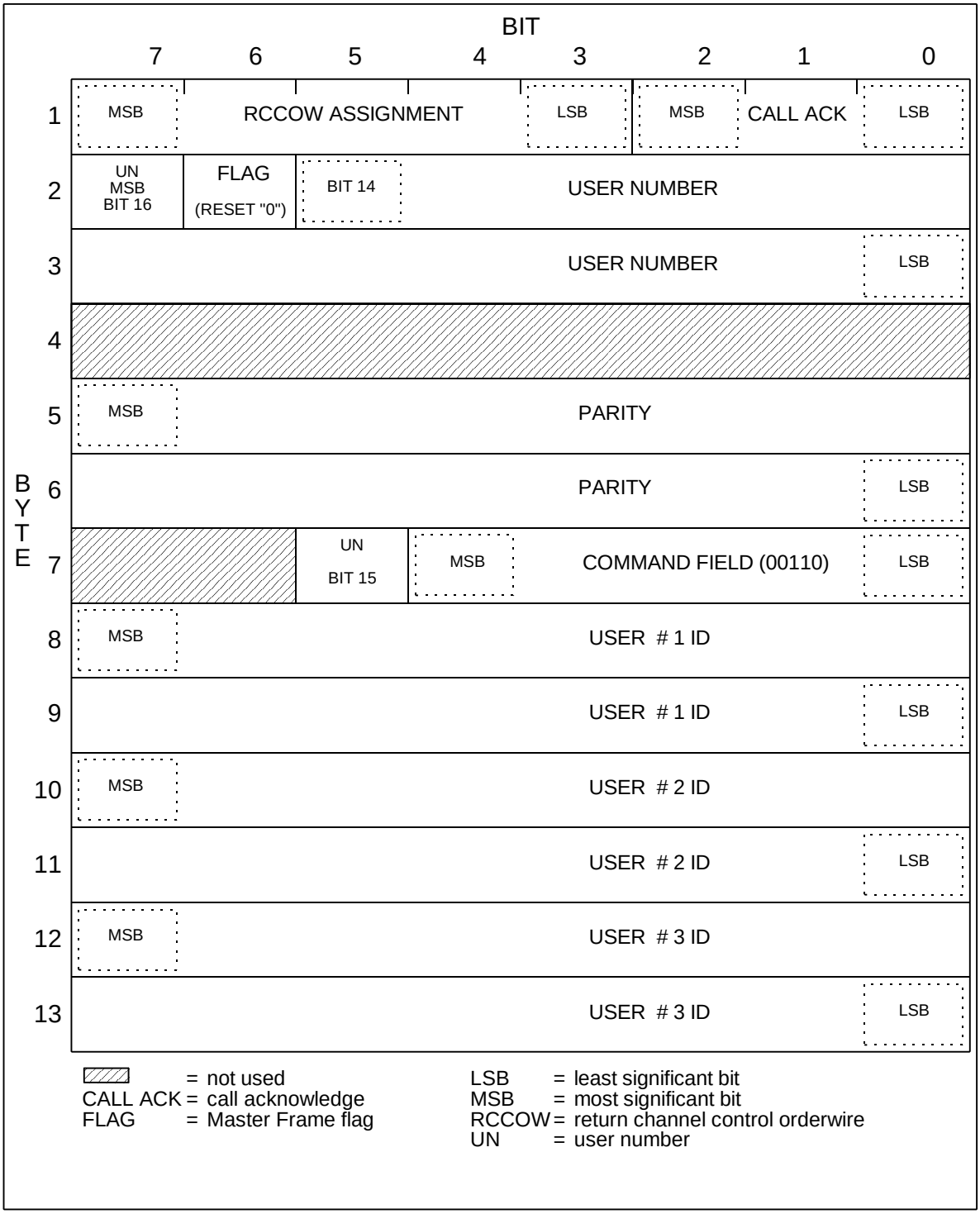

FIGURE B-8. CCOW:Call Canceled.

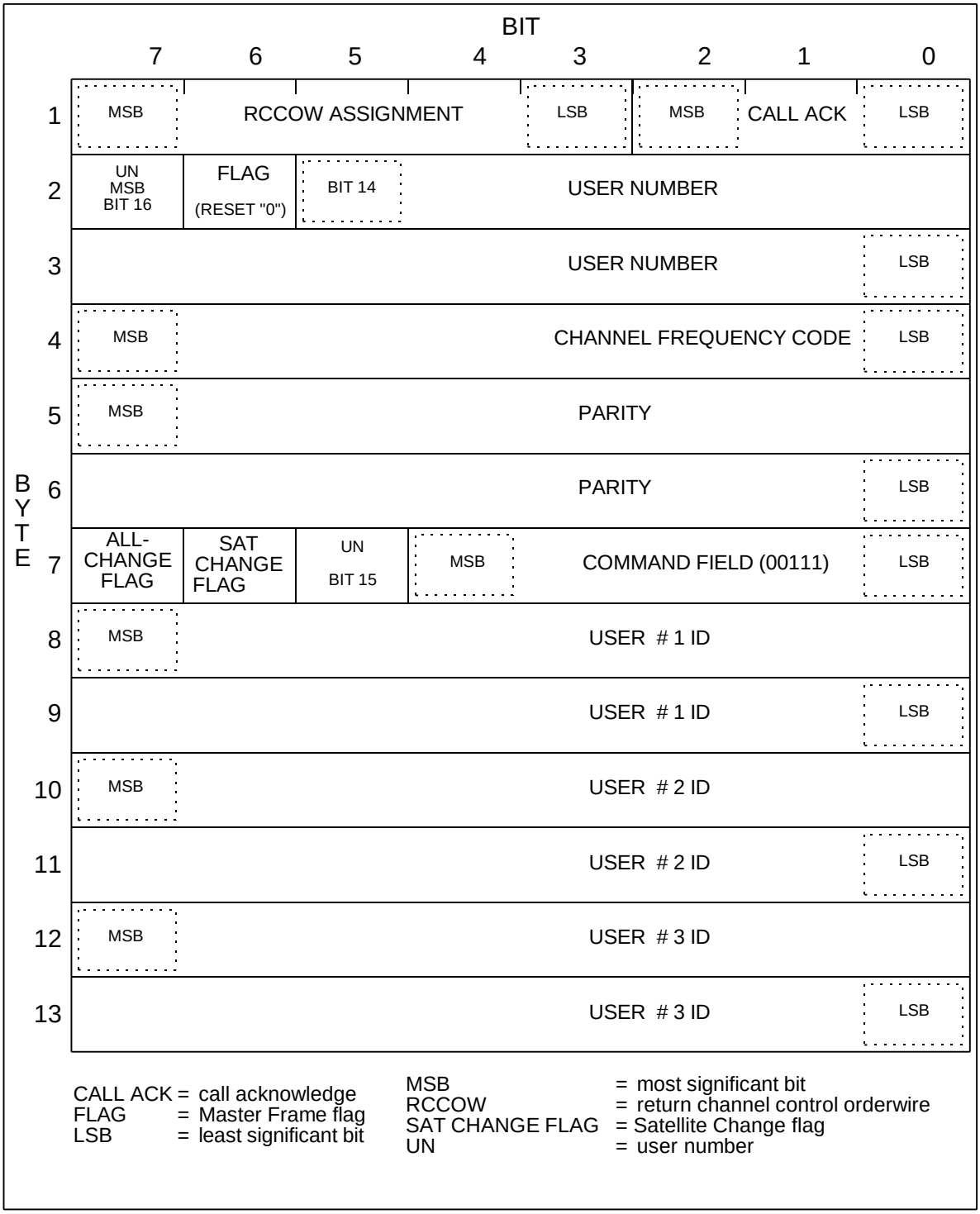

FIGURE B-9. CCOW:TDMA Channel Reassignment.

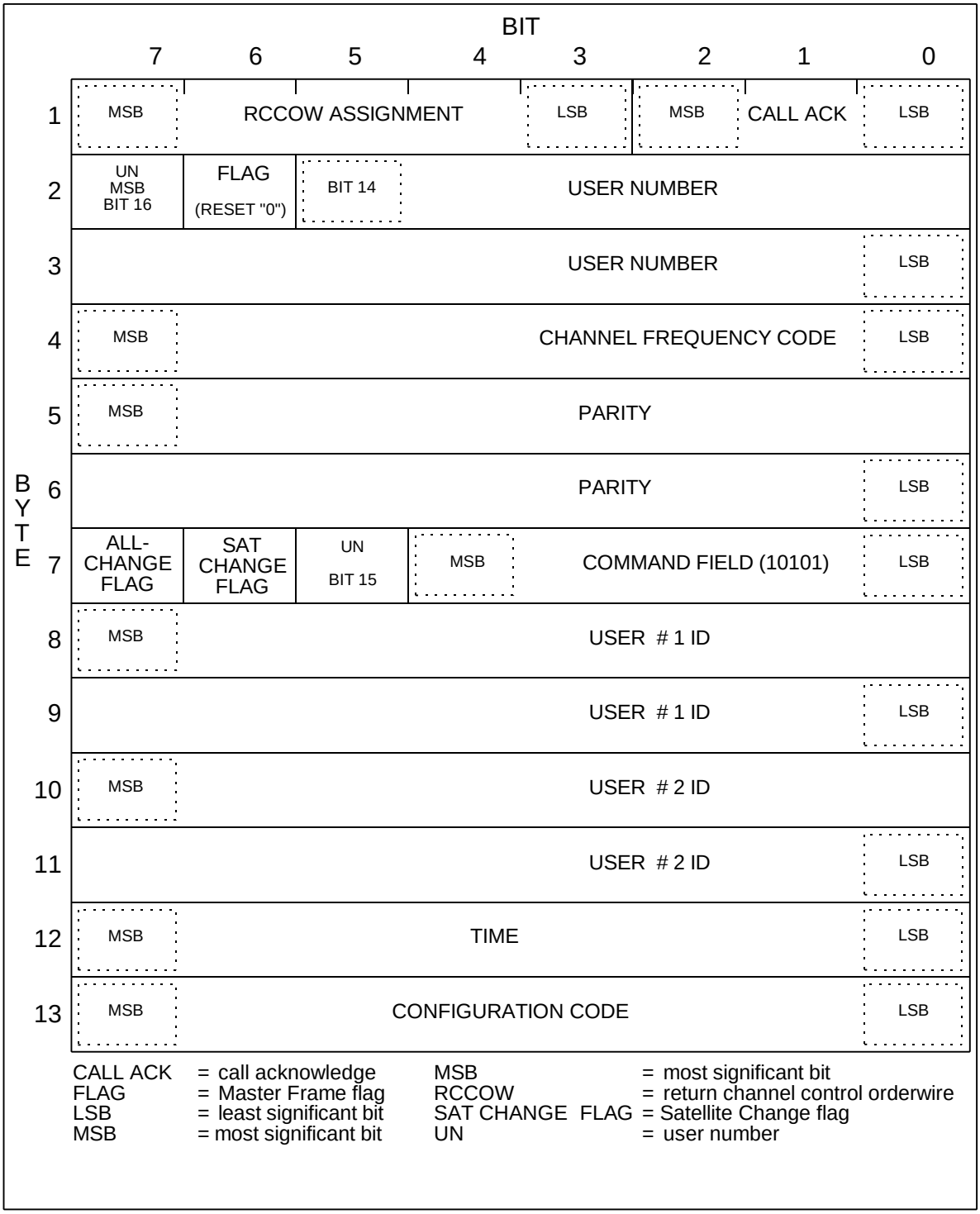

FIGURE B-10. CCOW:DASA Channel Assignment.

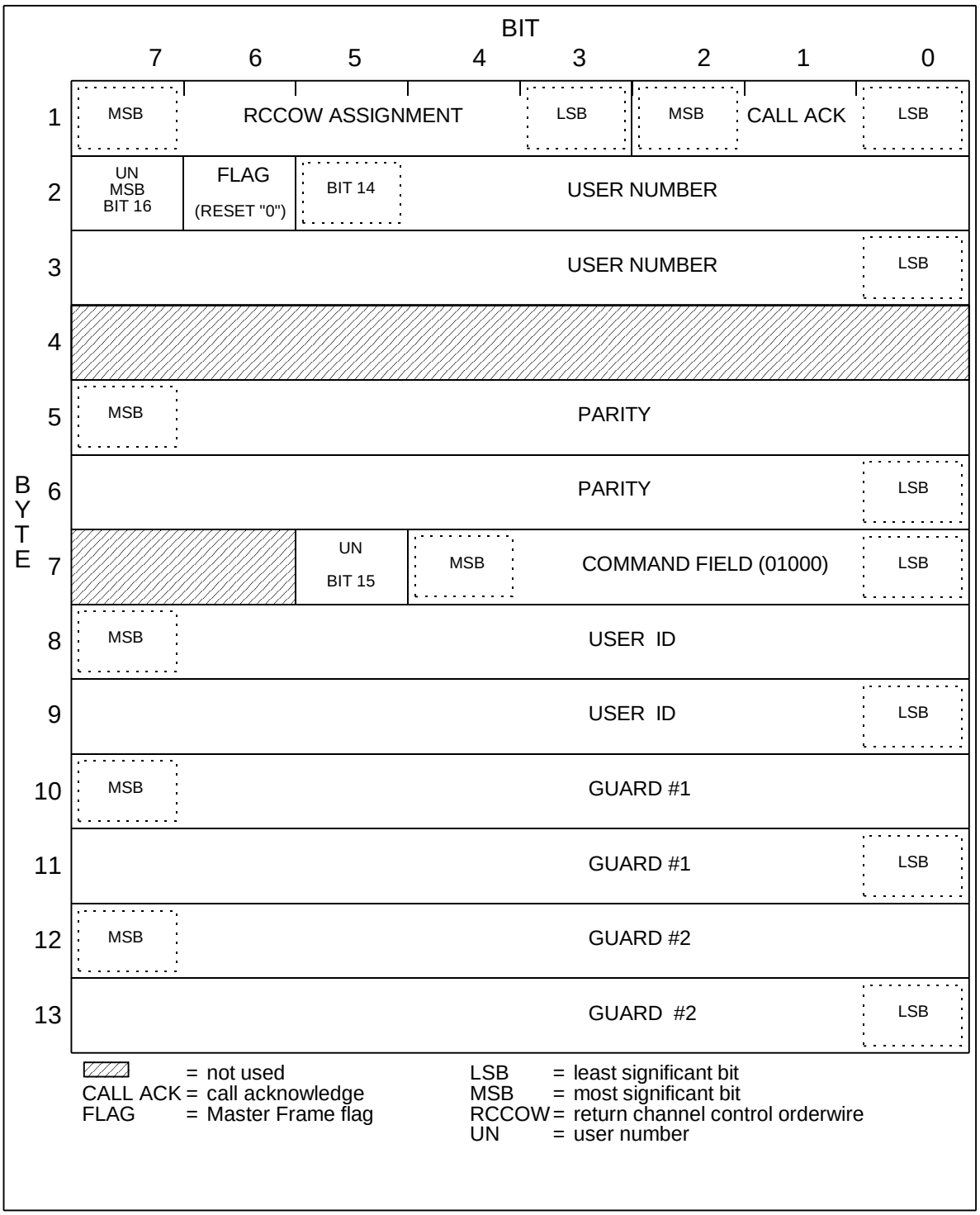

FIGURE B-11. CCOW:Enter Guard List.

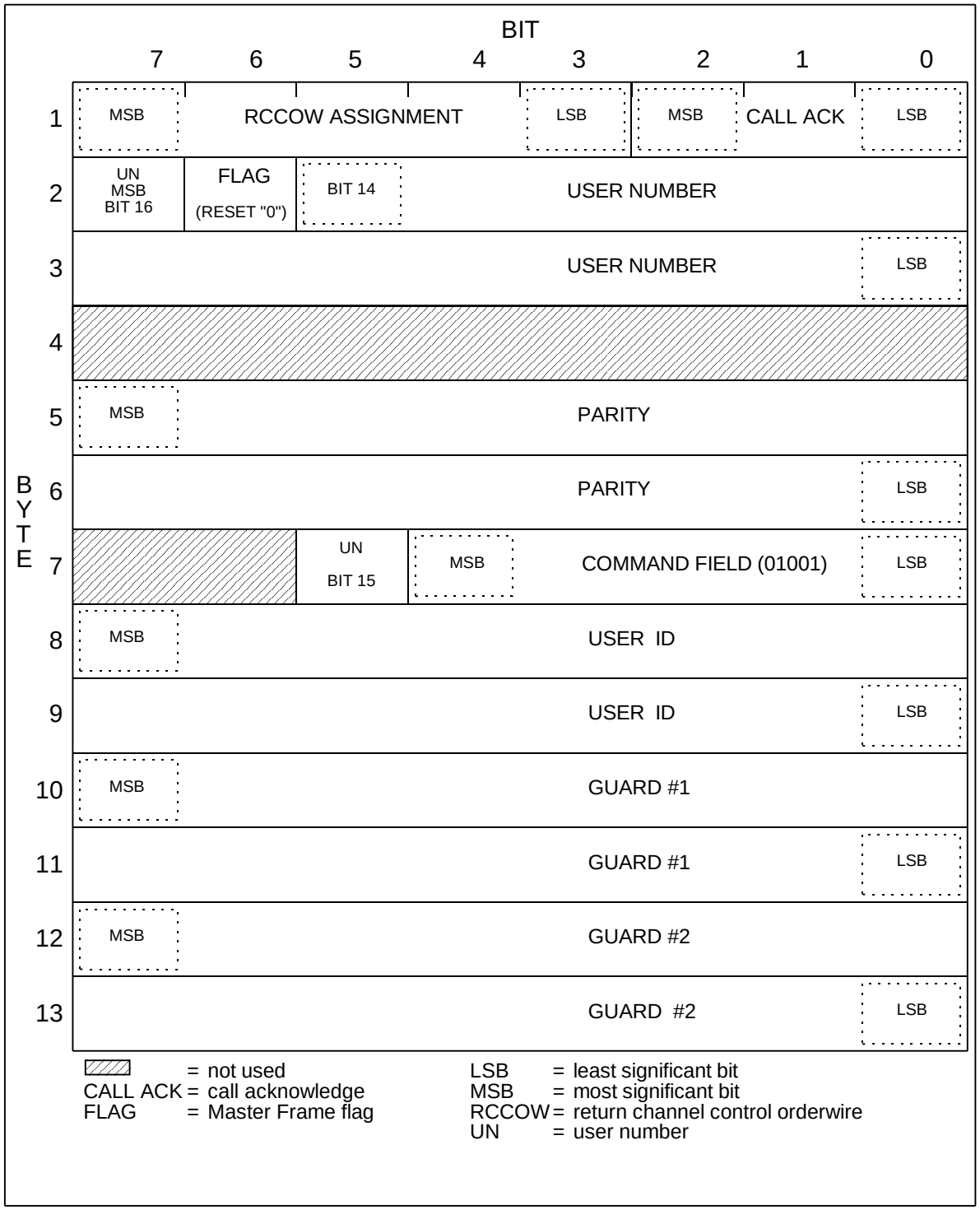

FIGURE B-12. CCOW:Delete from Guard List.

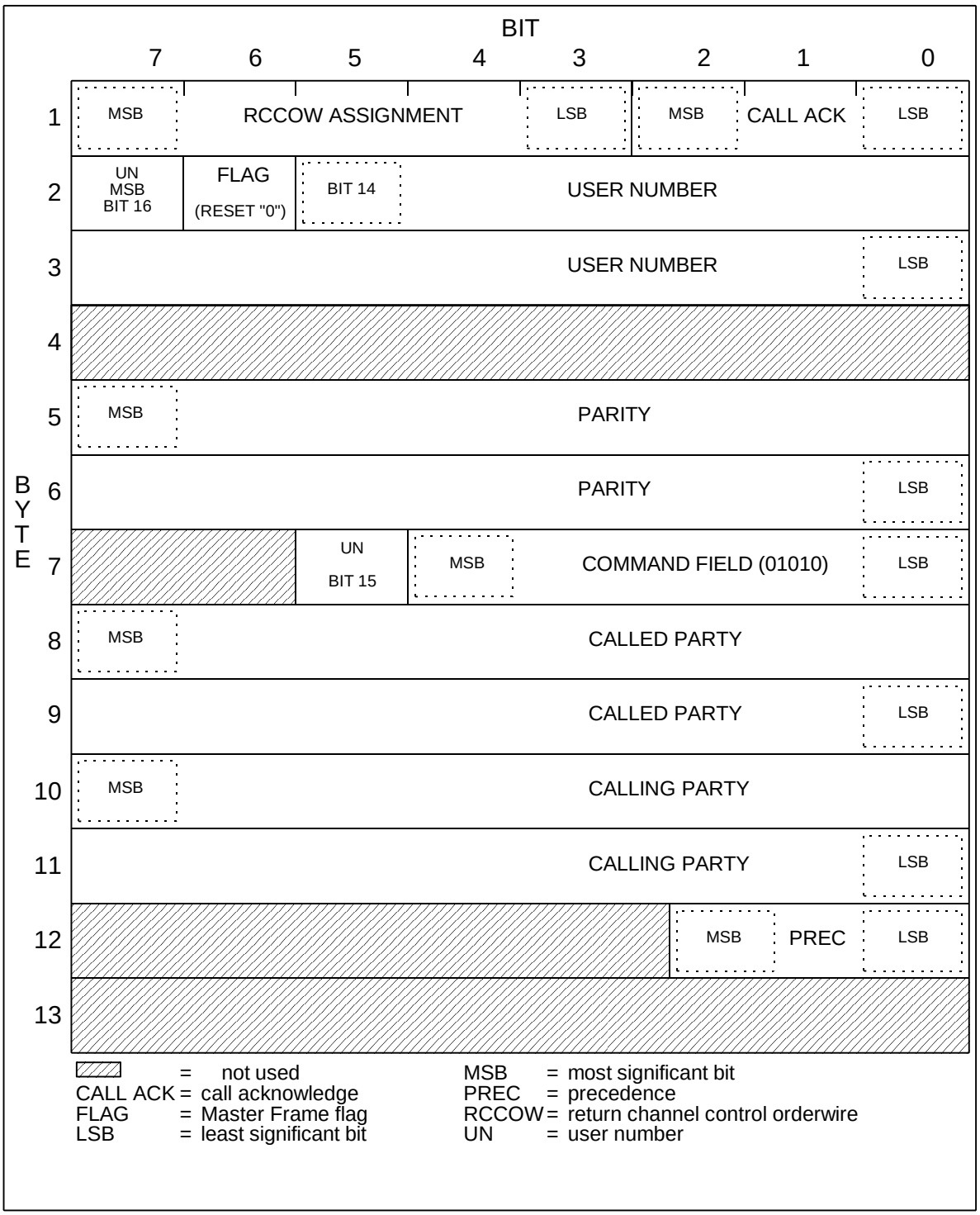

FIGURE B-13. CCOW:Call Waiting.

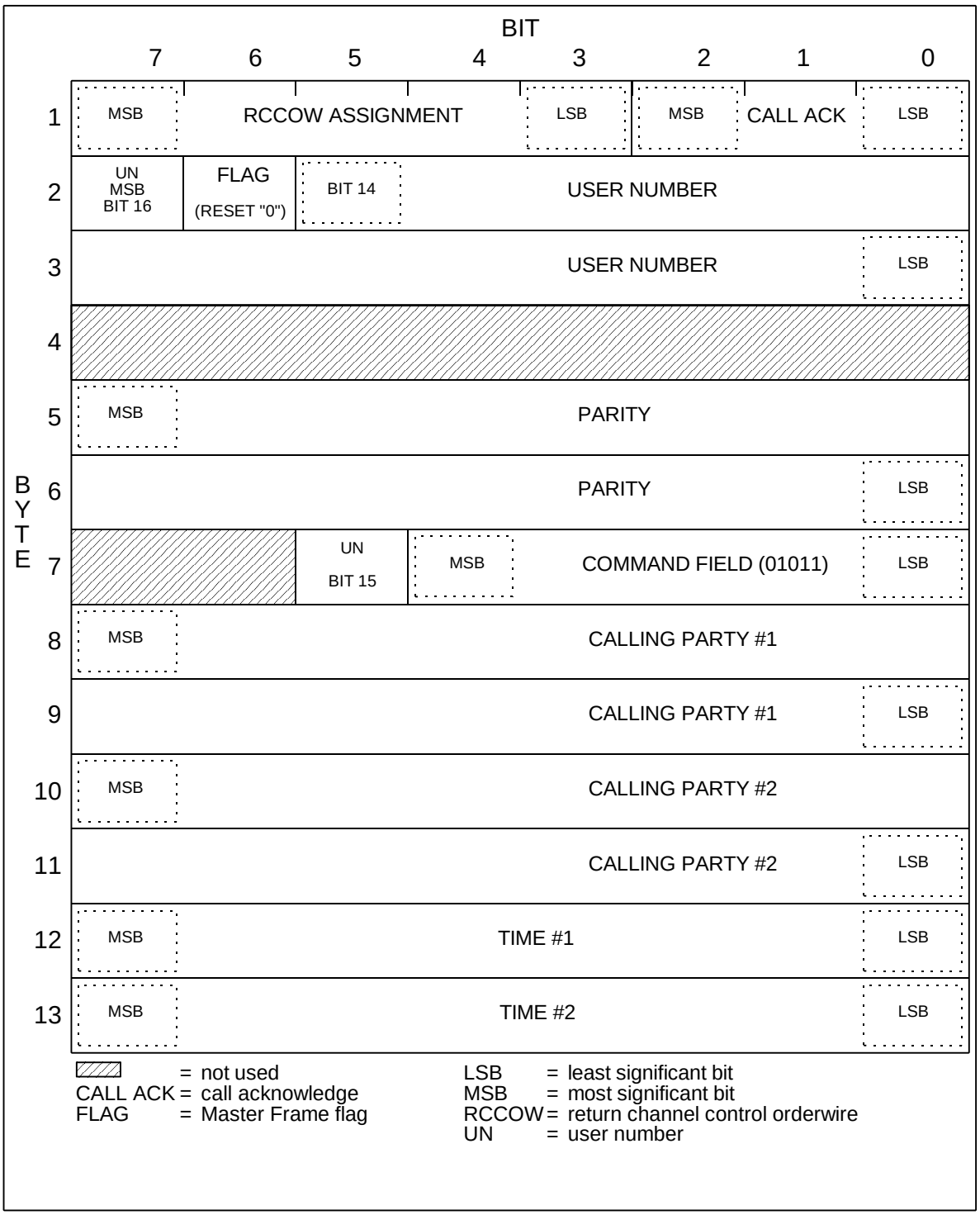

FIGURE B-14. CCOW:Call in Queue.

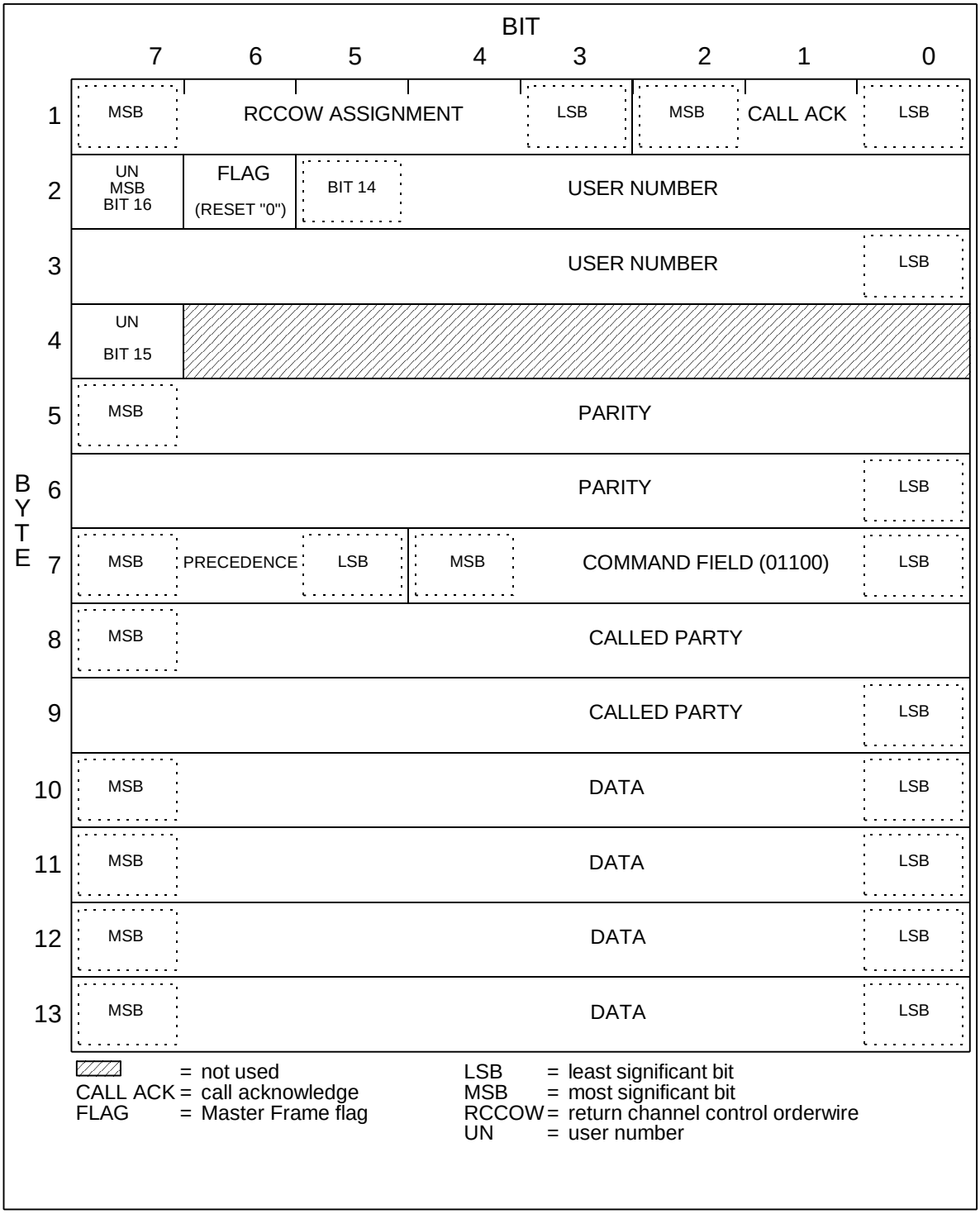

FIGURE B-15. CCOW:Computer Data Transfer.

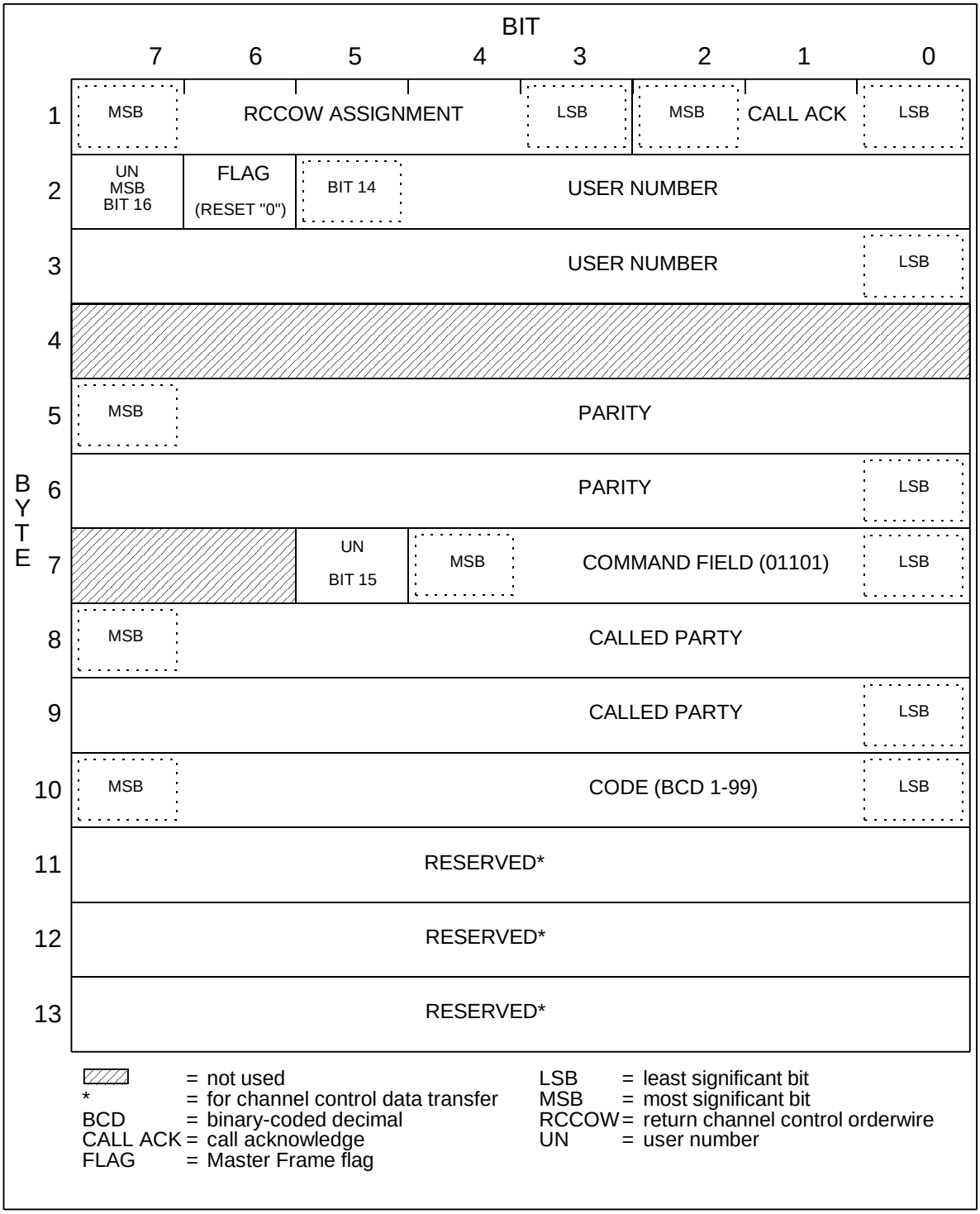

FIGURE B-16. CCOW:Information Request.

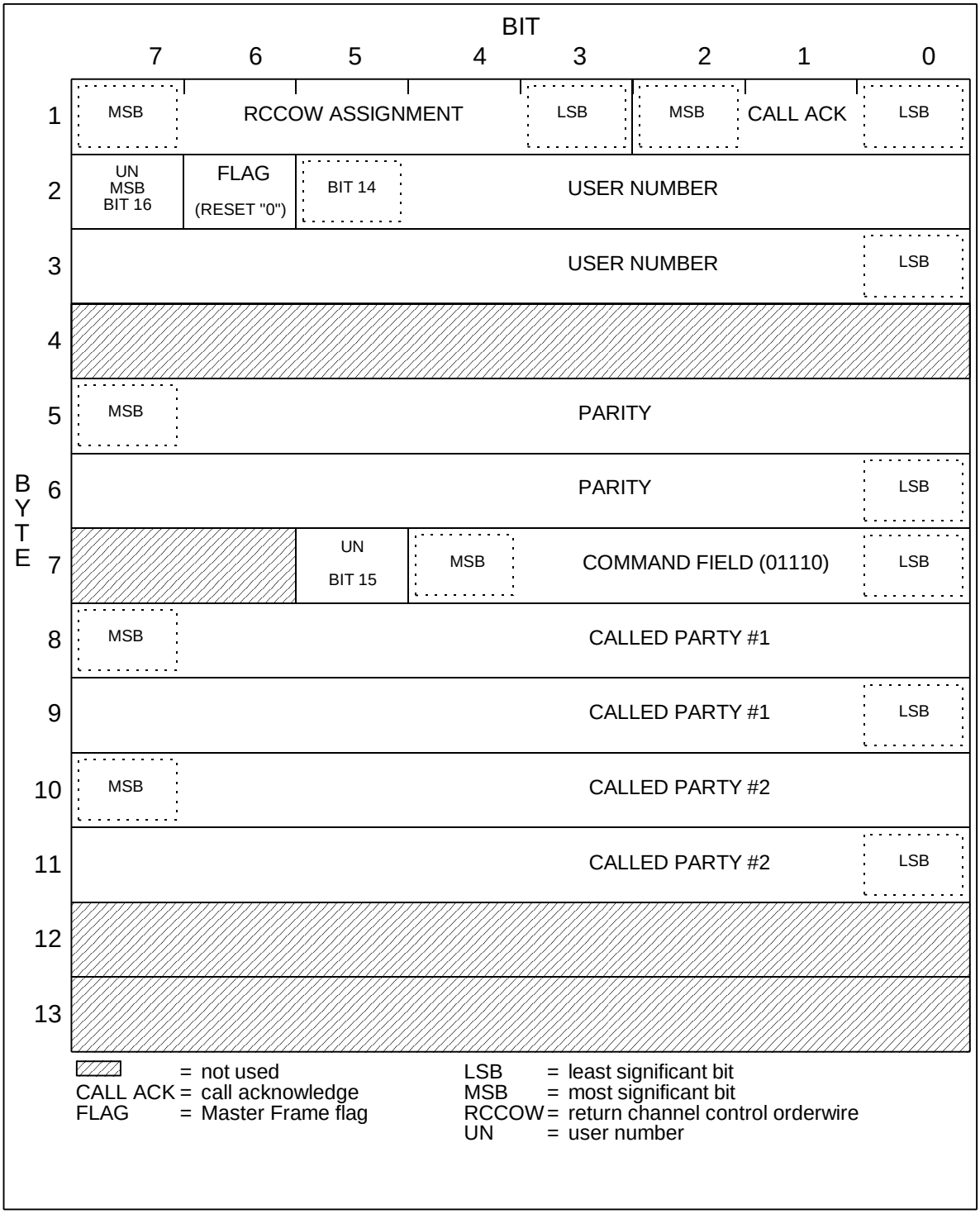

FIGURE B-17. CCOW:Zeroize.

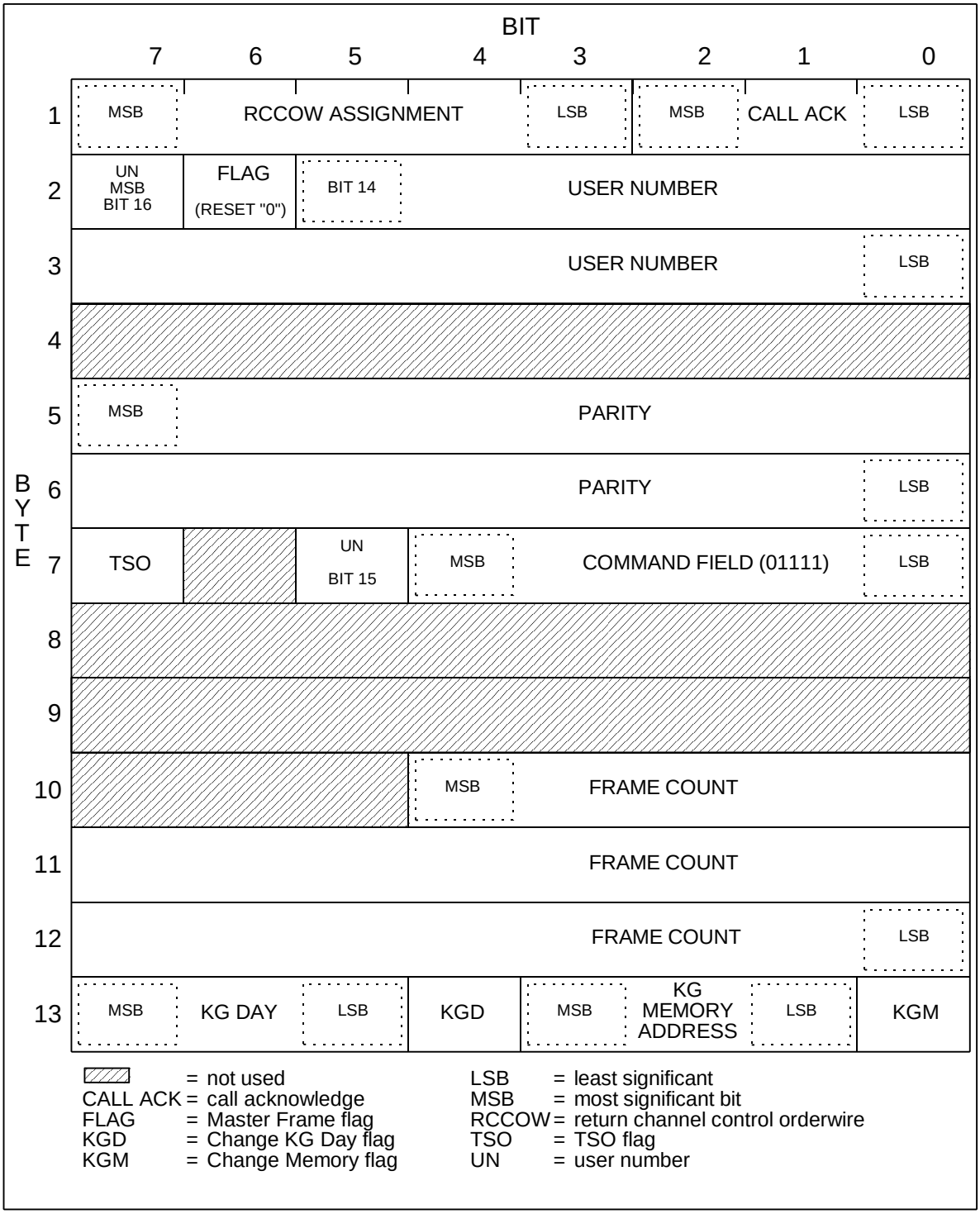

FIGURE B-18. CCOW:Time Slot Preparation.

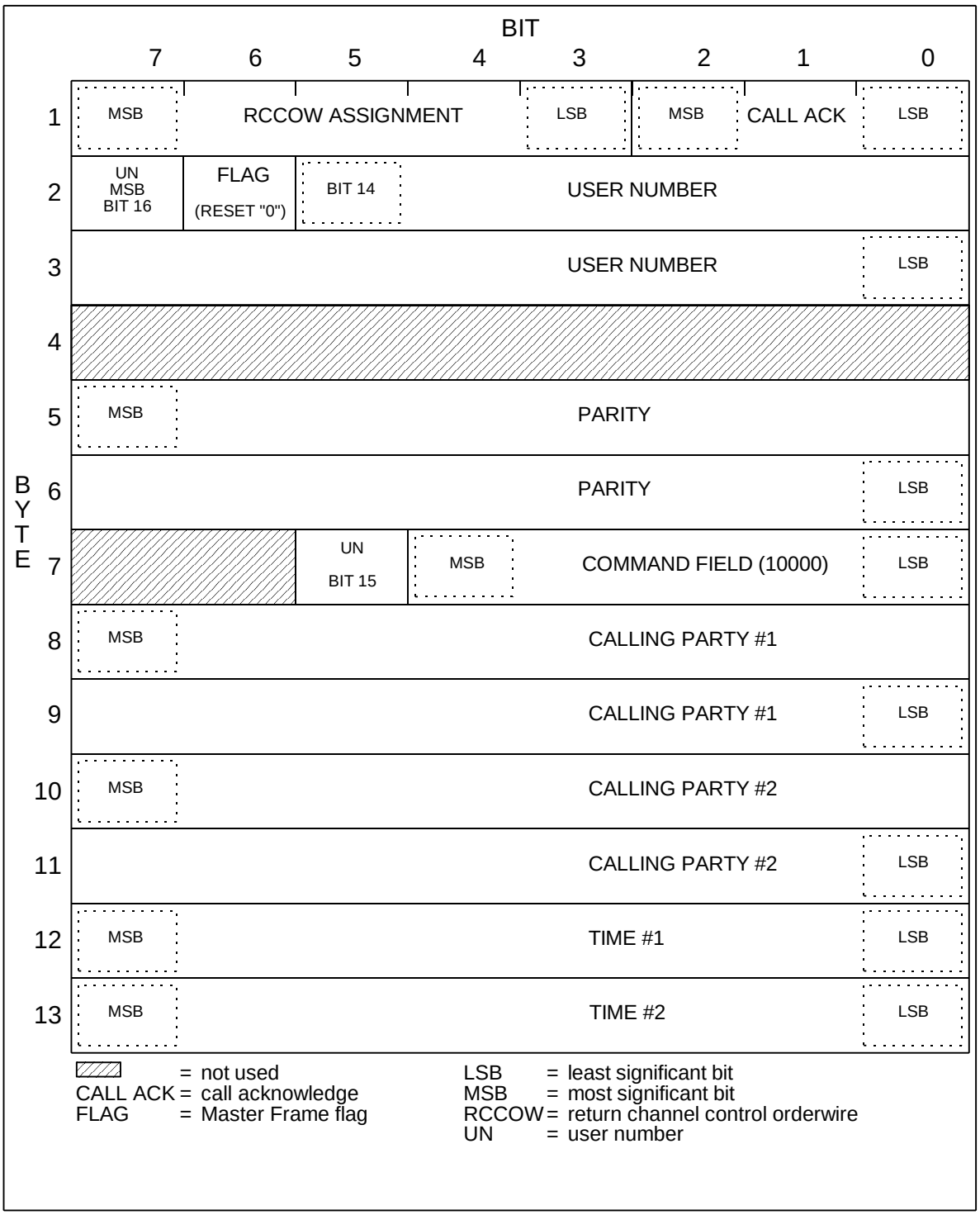

FIGURE B-19. CCOW:Requested Party Out-of-Service.

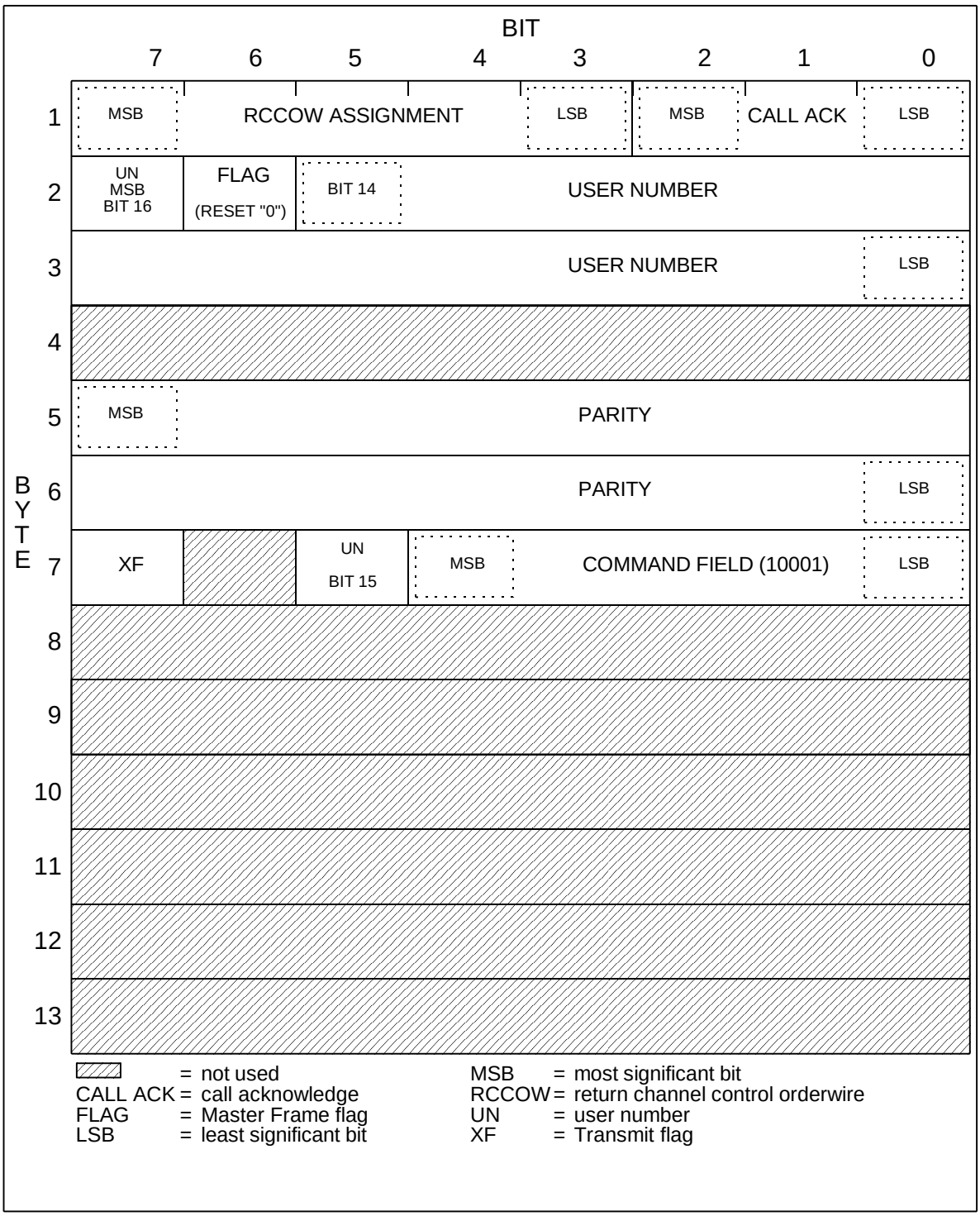

FIGURE B-20. CCOW:Transmit Control.

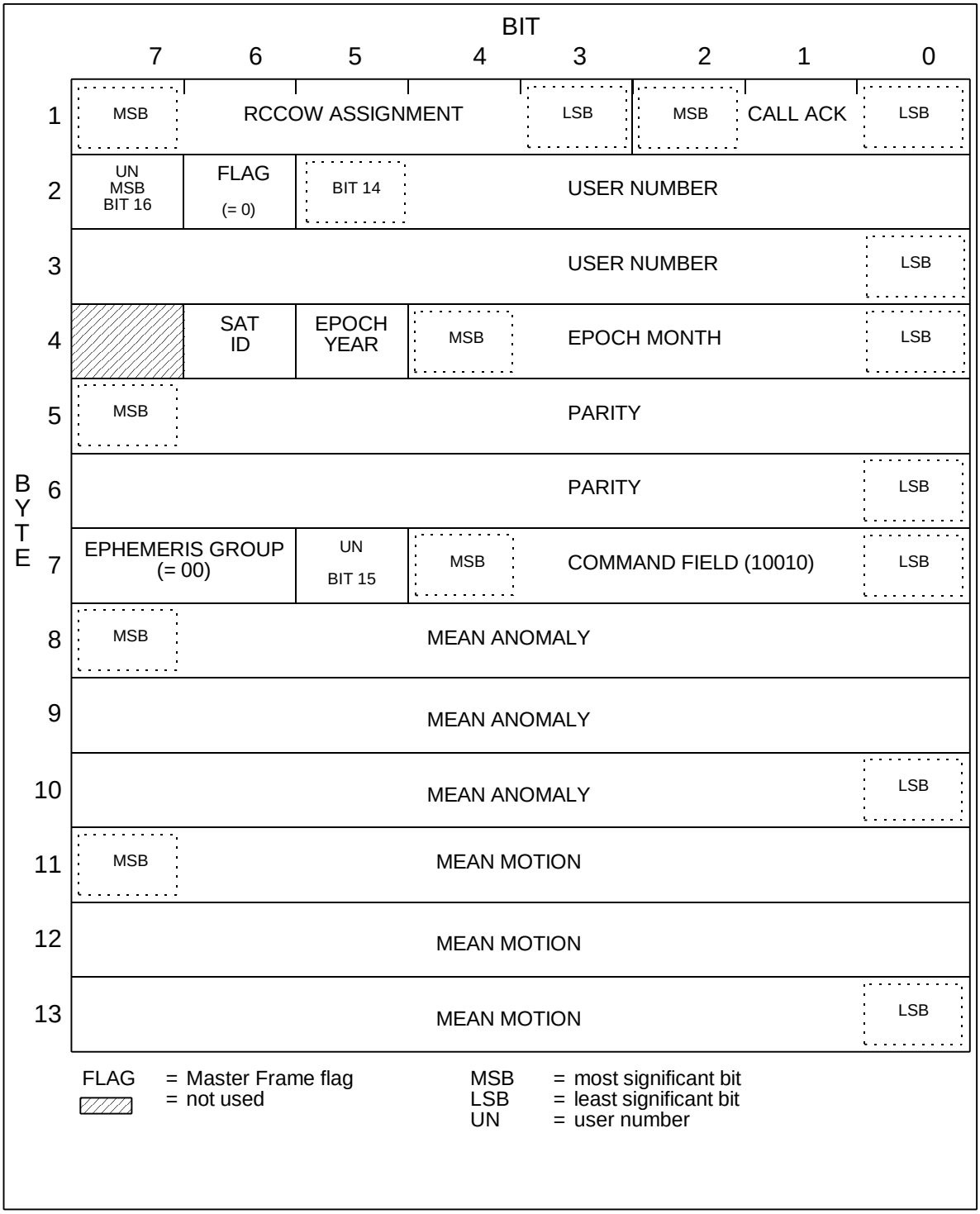

FIGURE B-21A. CCOW:Satellite Ephemeris Data Message 1.

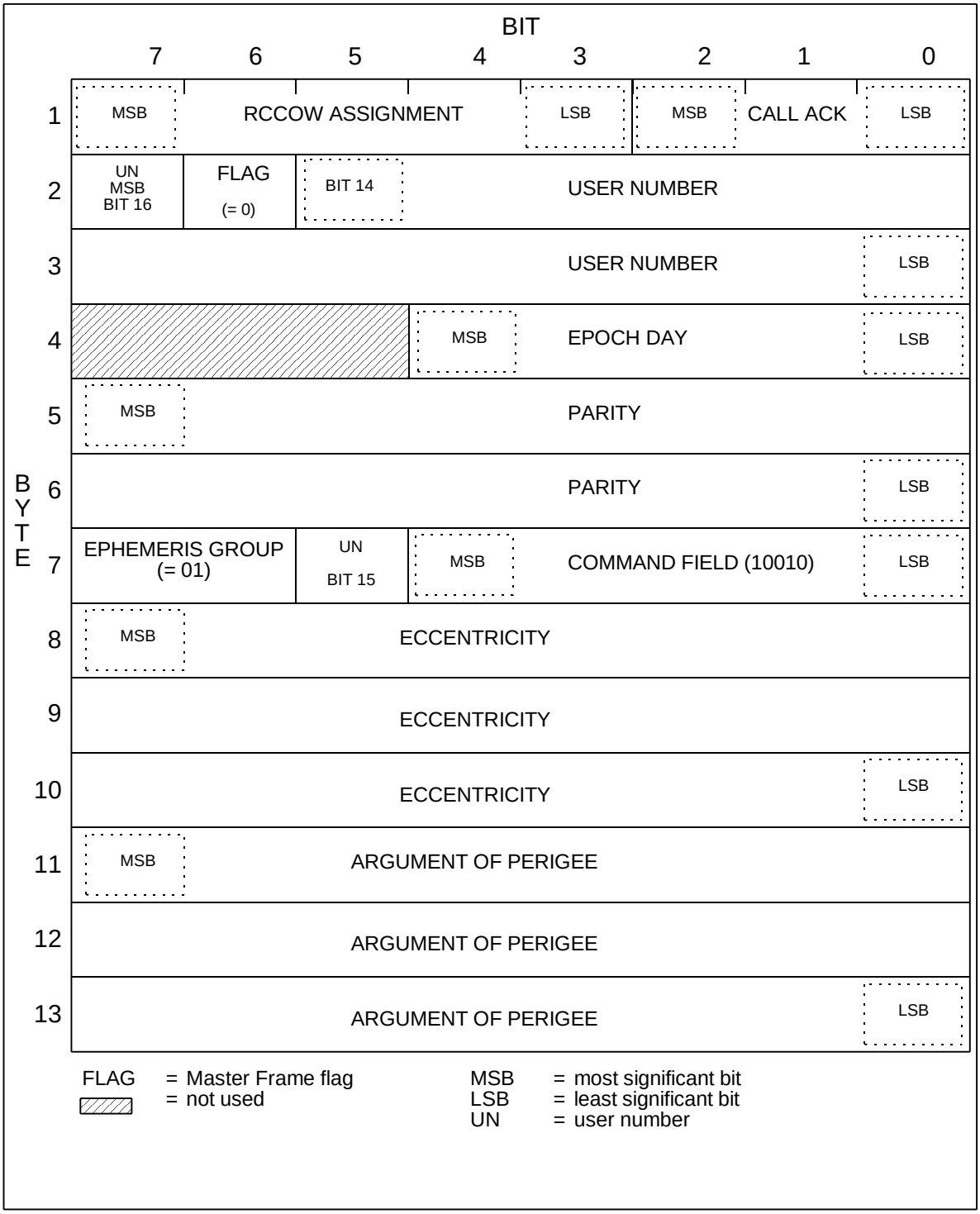

FIGURE B-21B. CCOW:Satellite Ephemeris Data Message 2.

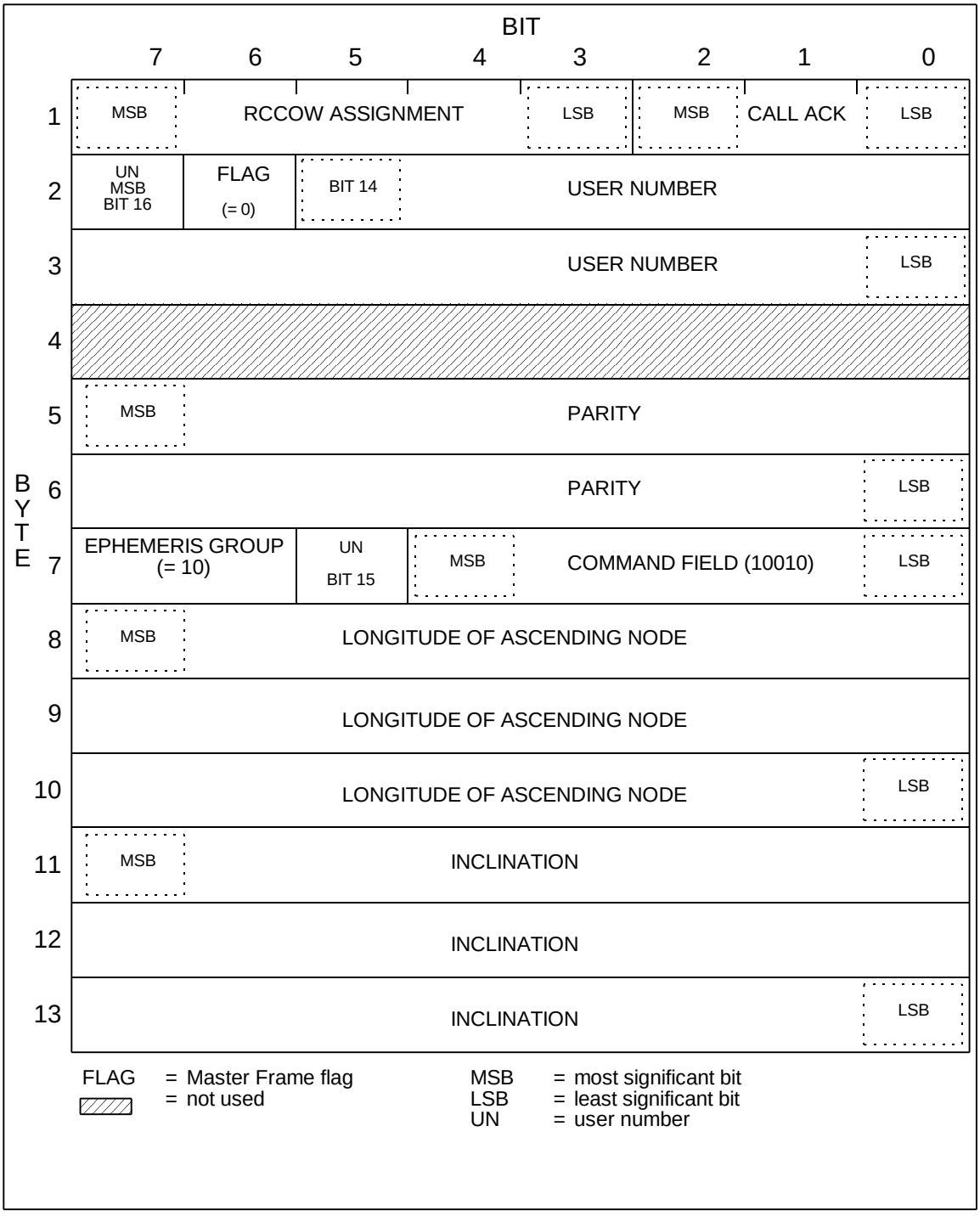

FIGURE B-21C. CCOW:Satellite Ephemeris Data Message 3.

APPENDIX C

RCCOW MESSAGE FORMATS

C.1 SCOPE

This Appendix is a mandatory part of this standard. The information contained herein is intended for compliance. Each RCCOW message is defined by bits within bytes. Where a portion of the available bits is not used, the bits are noted by shading. There is one exception. The unique fields in the RCCOW:Acknowledge Channel Control Request message are shaded but will be used. These fields will be defined in MIL-STD-188-185. Each terminal operating in the AC mode shall be able to generate each of the RCCOW messages defined herein with exceptions as follows: (1) RCCOW:Acknowledge Channel Control Request message and (2) RCCOW:Data Transfer message unless required by terminal specification. Two of the orderwire messages listed below also apply to DC mode: (1) RCCOW:Data Transfer message and (2) RCCOW:Information Report message. Controllers will generate each of the RCCOWs as defined in Section 5.

C.2 CONTENTS

This appendix contains RCCOW messages as follows:

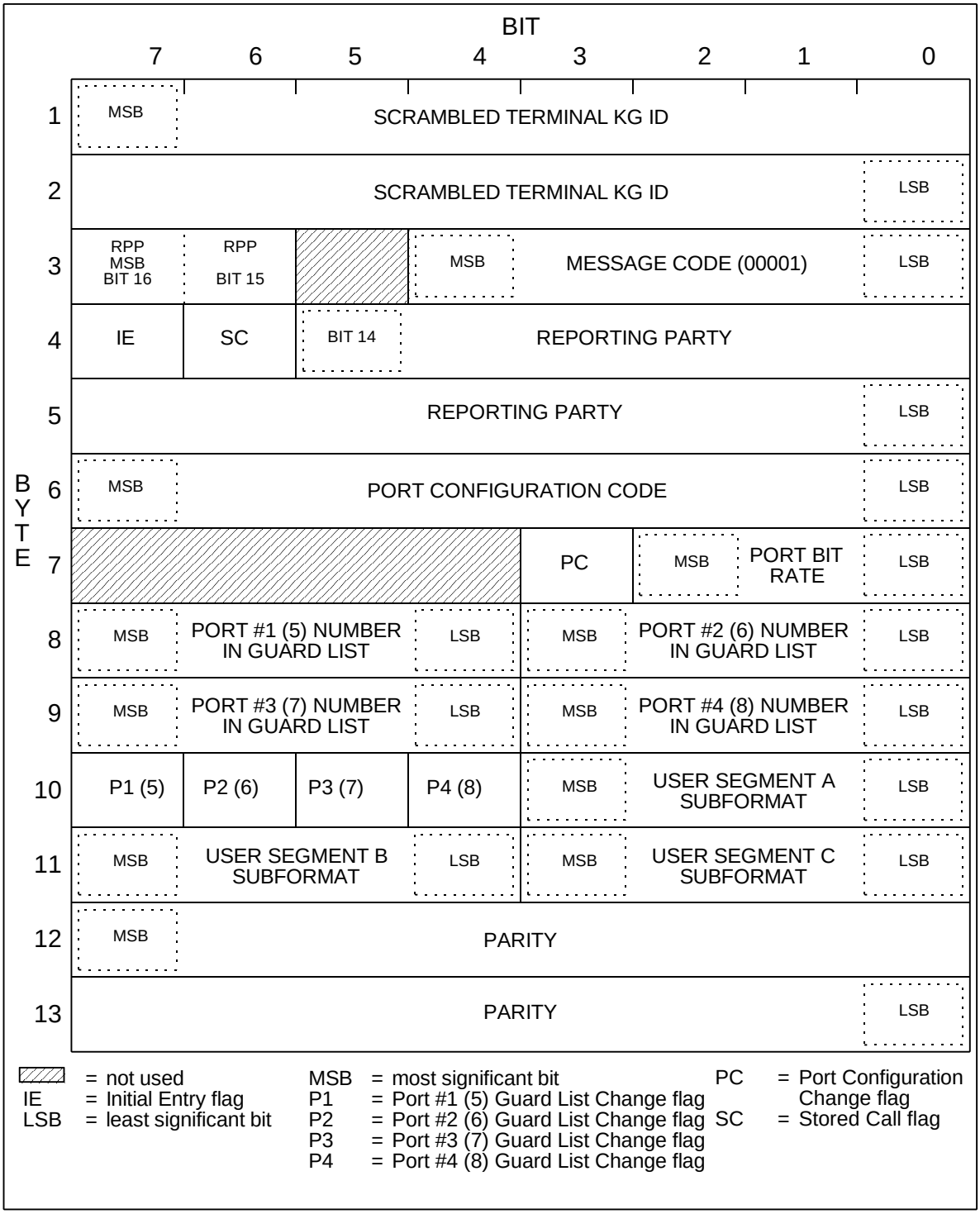

FIGURE C-1. RCCOW:Status Report B.

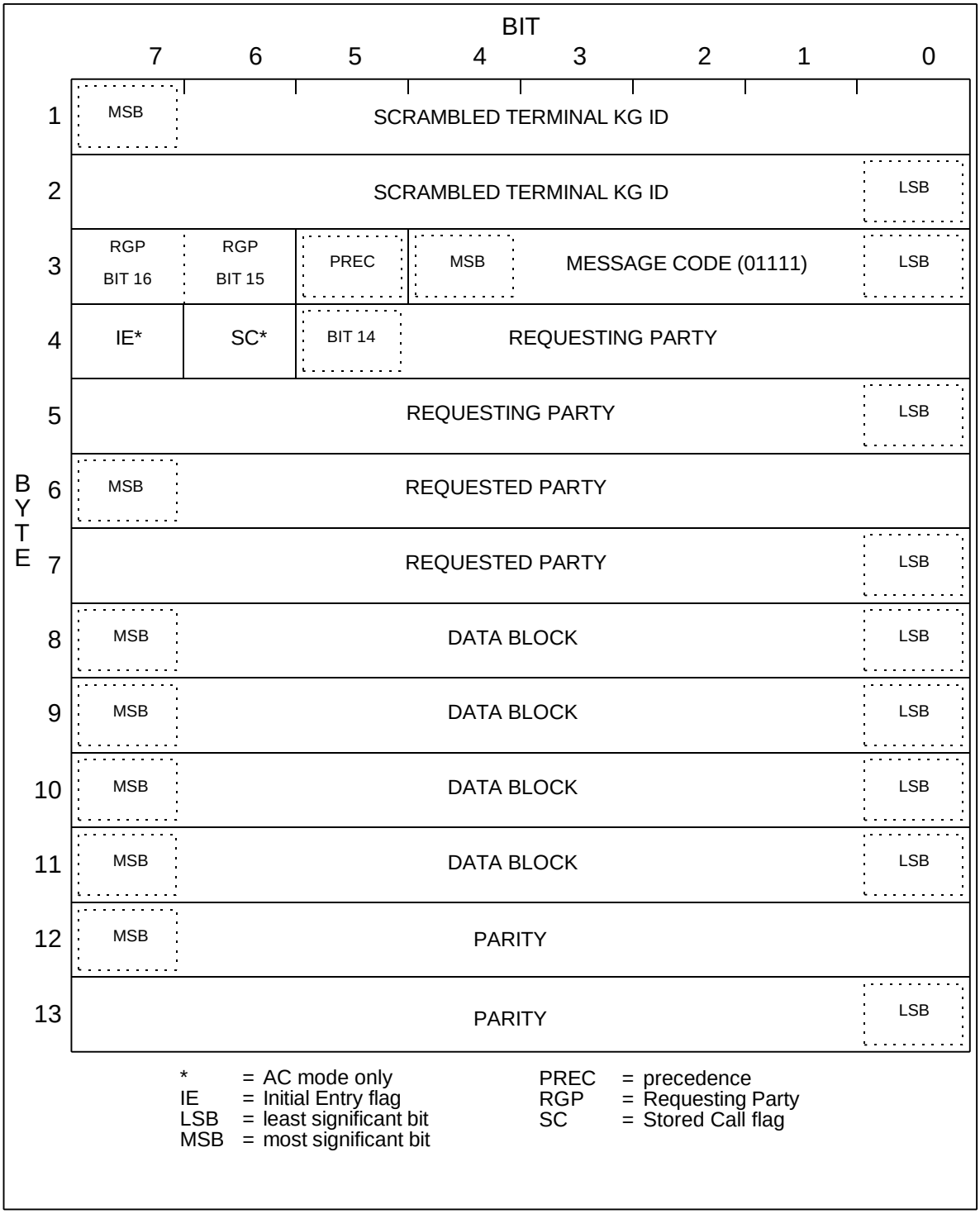

FIGURE C-2. RCCOW:Data Transfer (Type A).

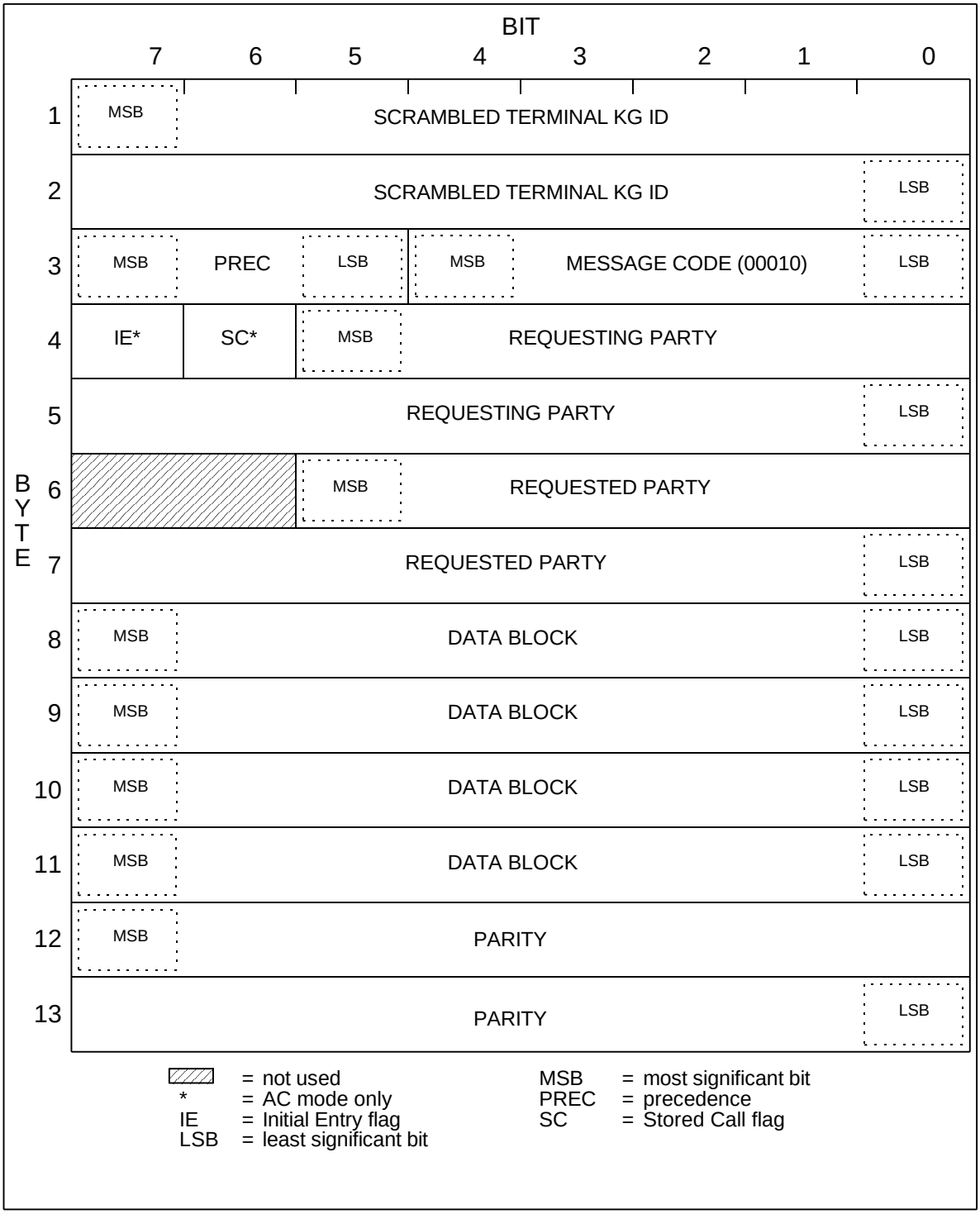

FIGURE C-3. RCCOW:Data Transfer (Type B).

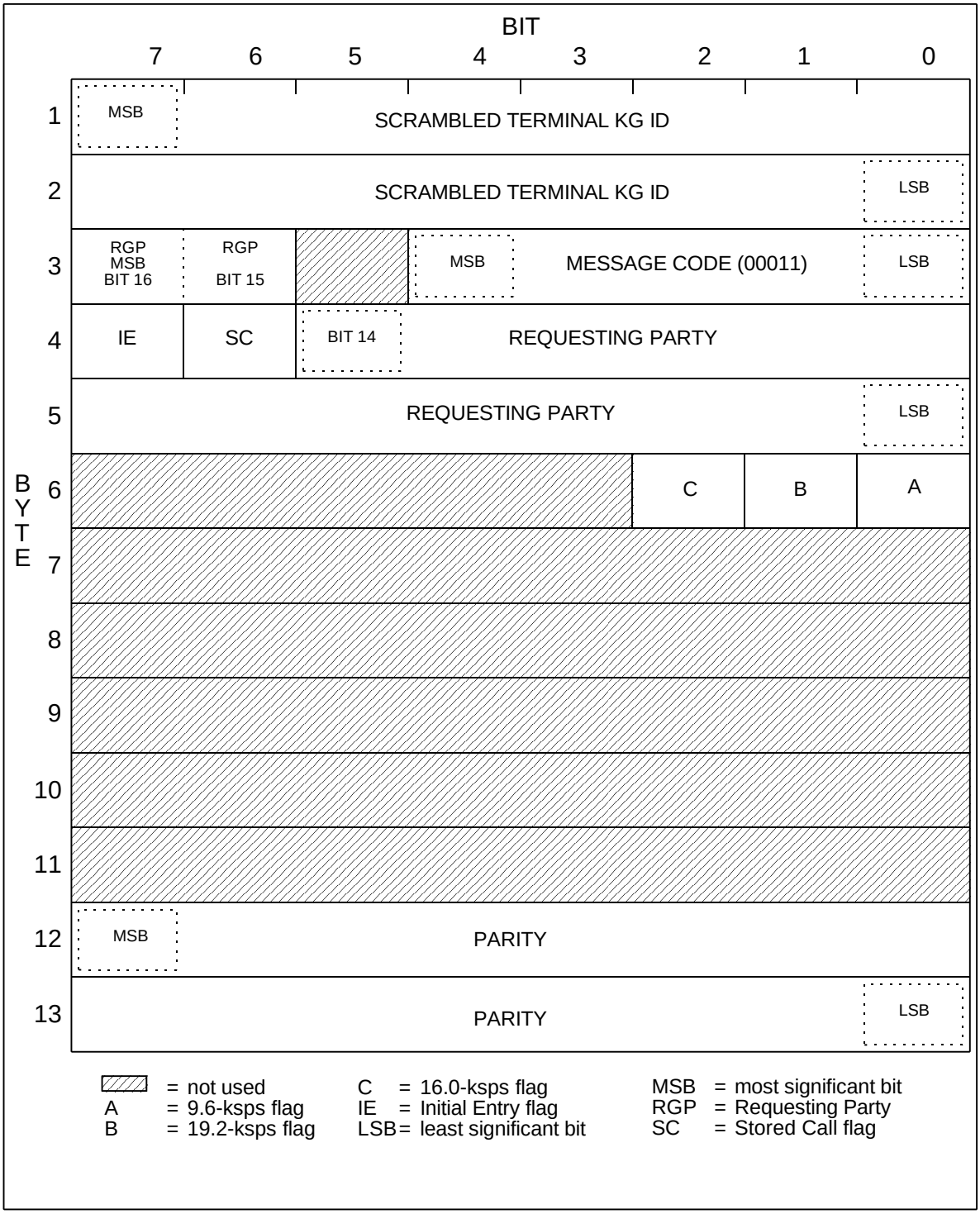

FIGURE C-4. RCCOW:Link Test Request.

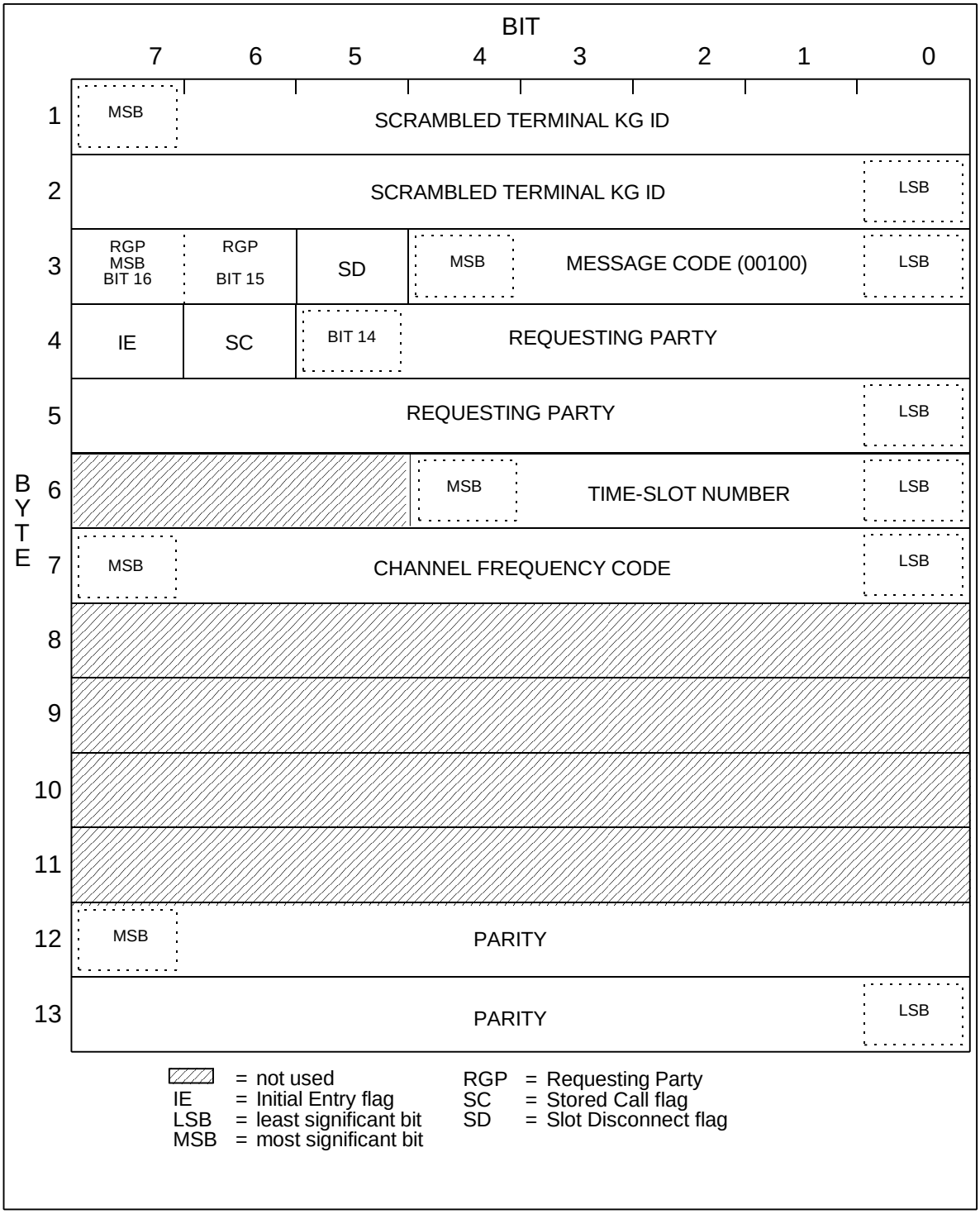

FIGURE C-5. RCCOW:Call Complete.

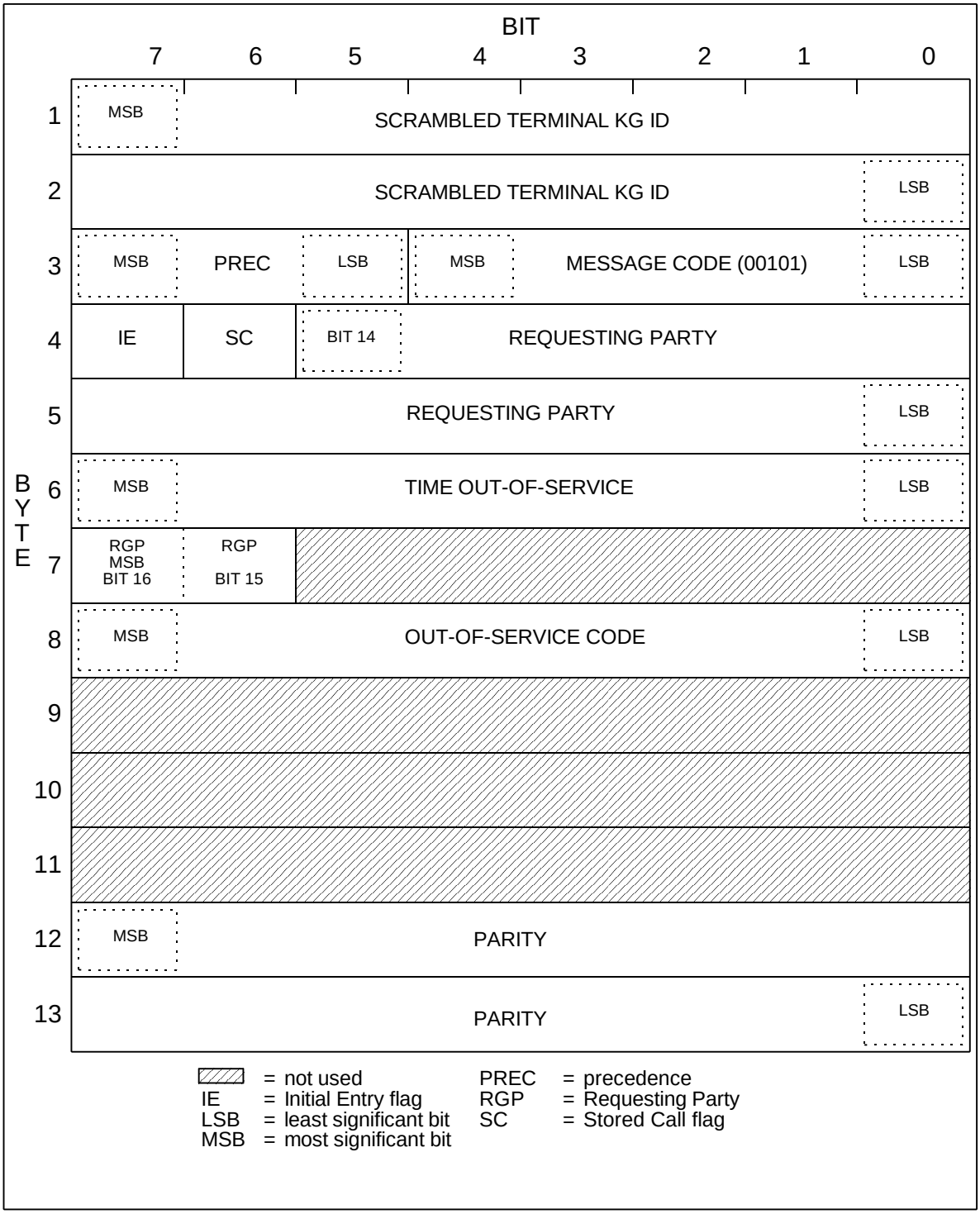

Figure C-6. RCCOW:Out-of-Service.

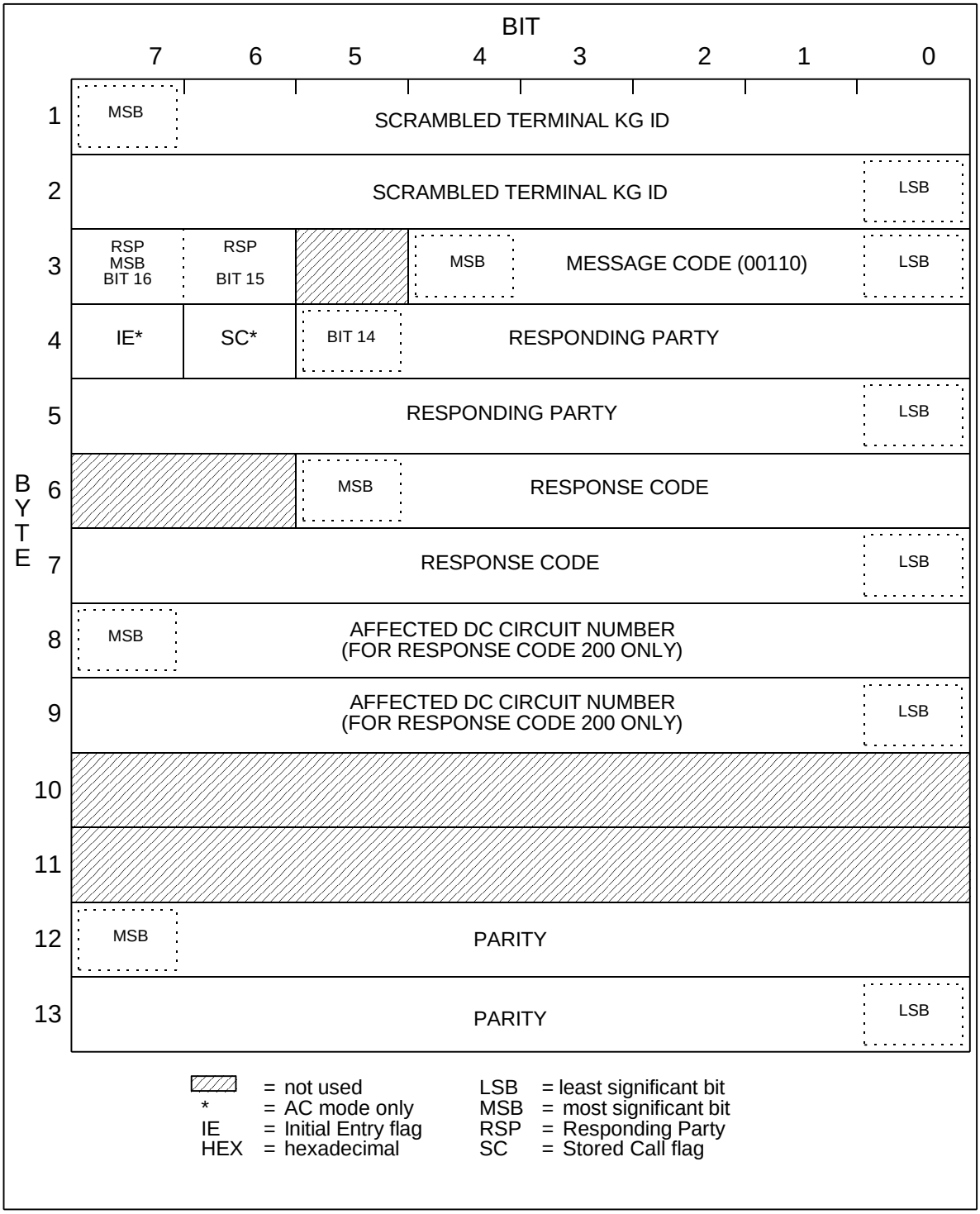

FIGURE C-7. RCCOW:Information Report.

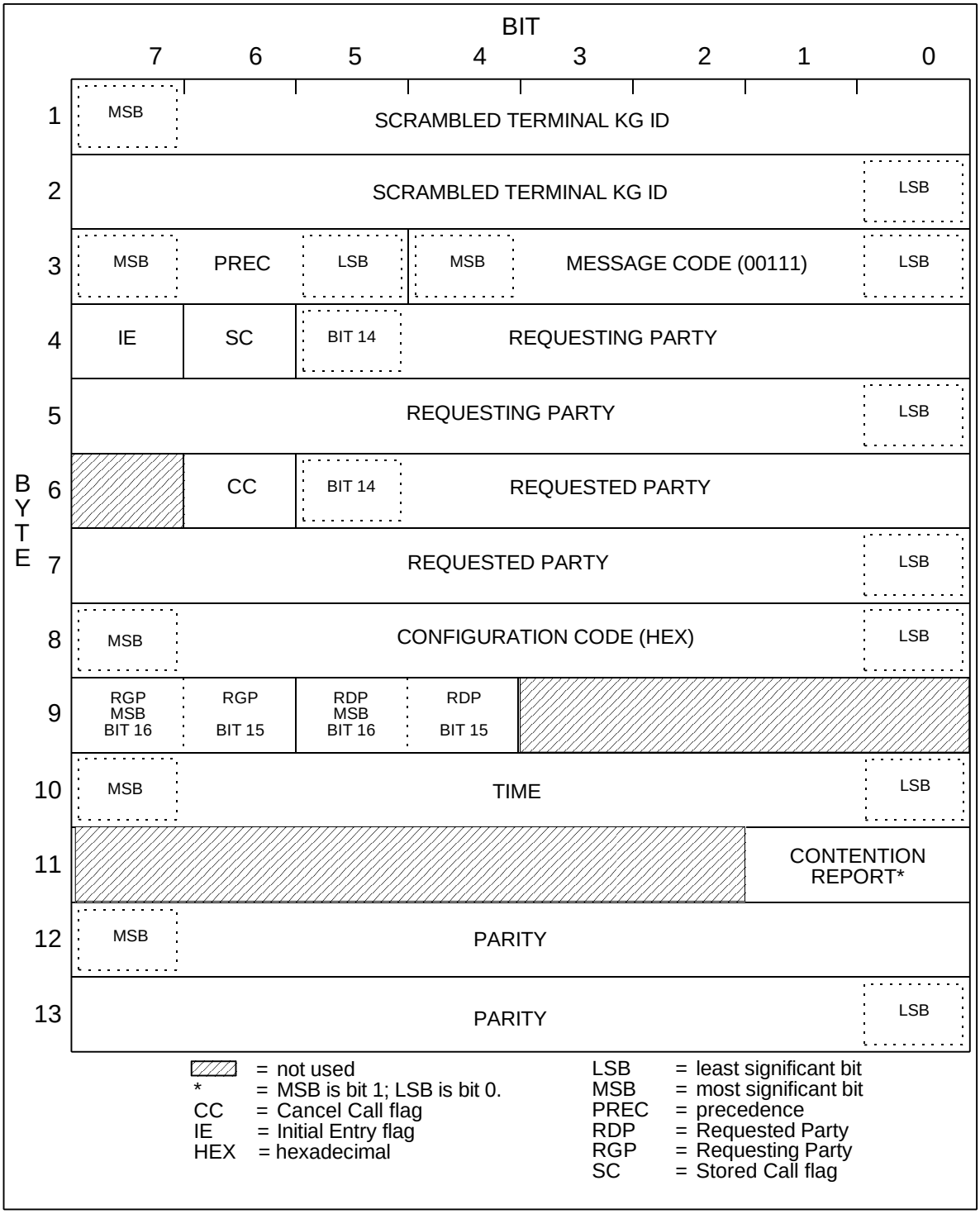

FIGURE C-8. RCCOW:Two-Party Request (or Cancel Call).

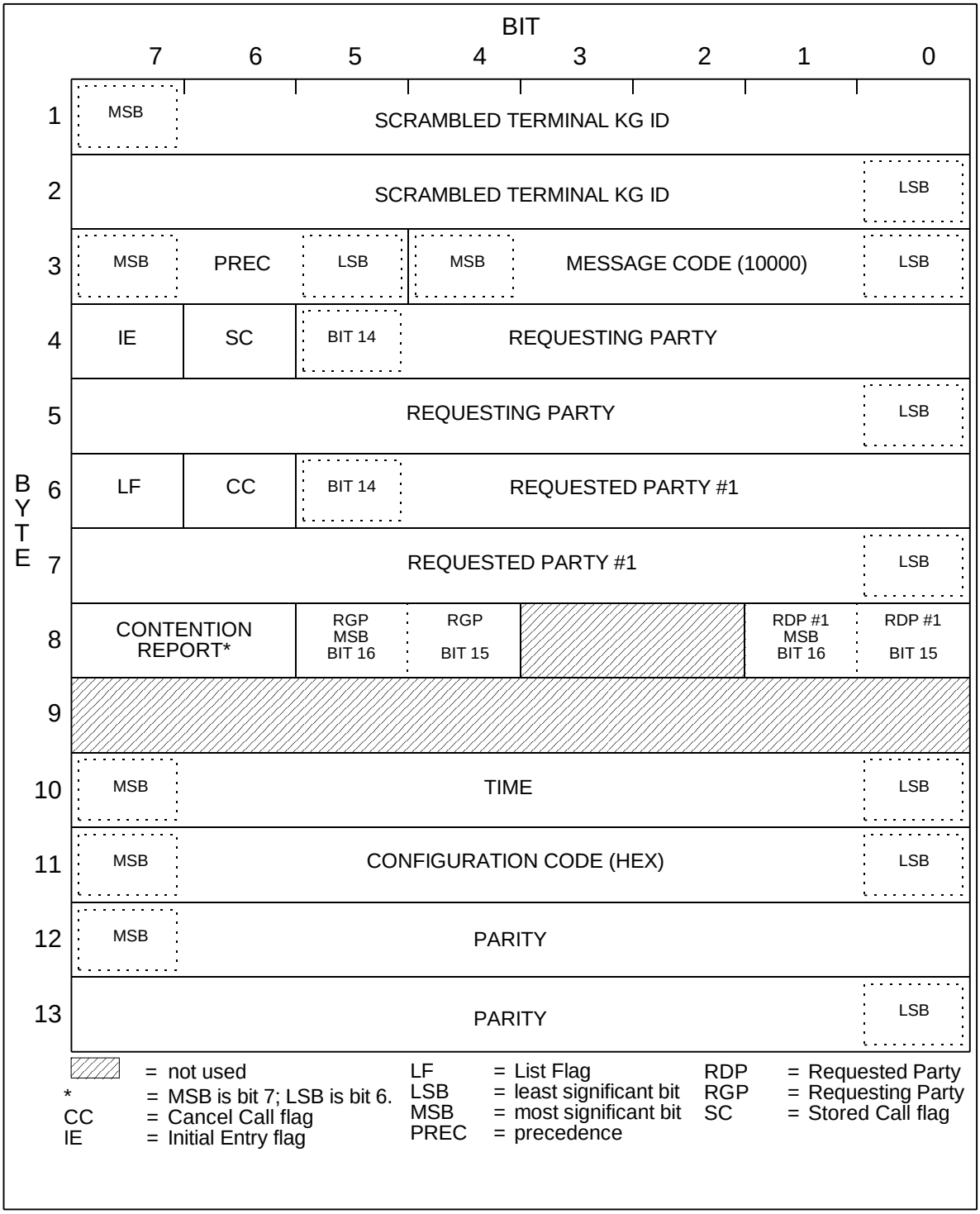

FIGURE C-9. RCCOW:Conference Request (or Cancel Call).

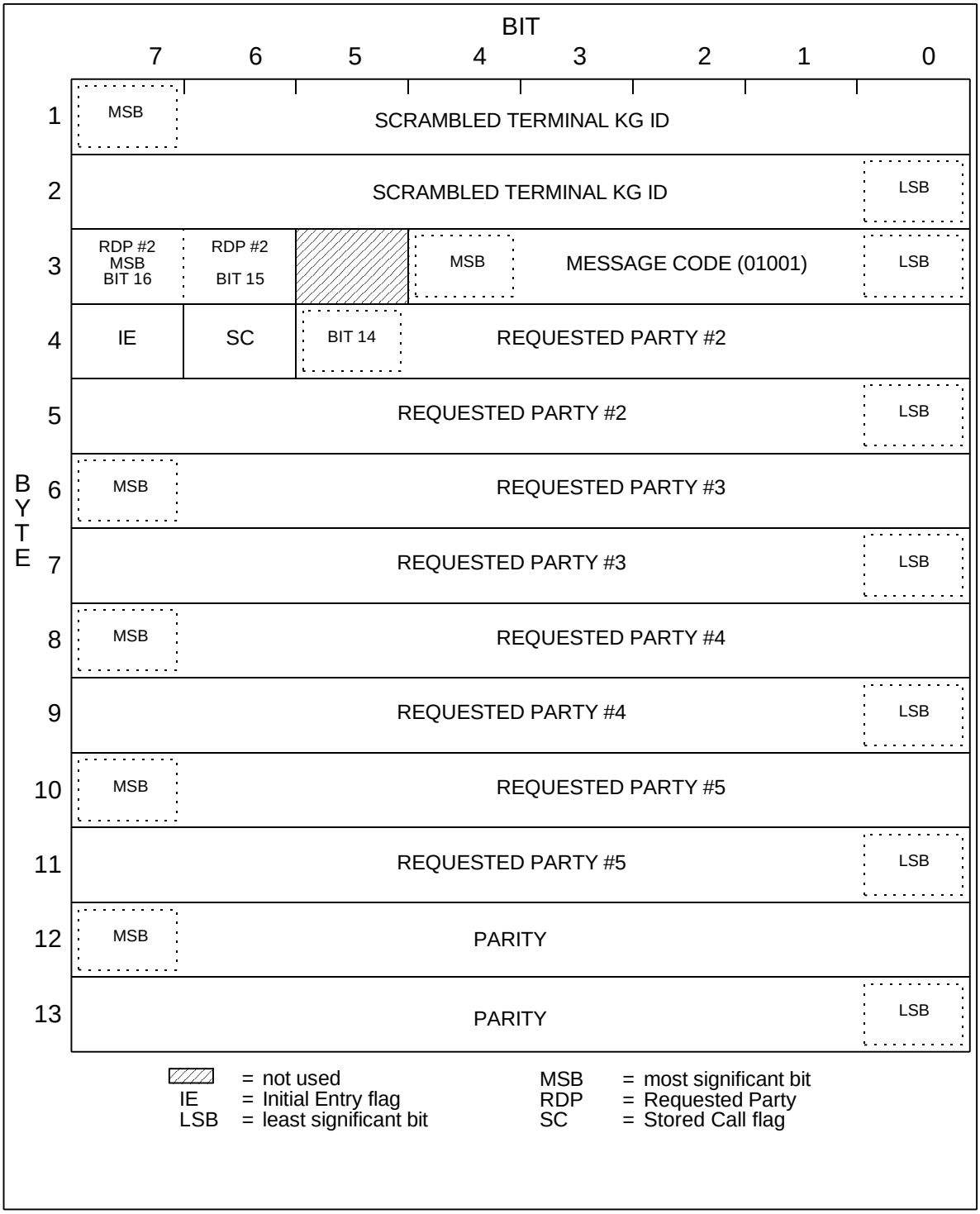

FIGURE C-10. RCCOW:Conference Party List.

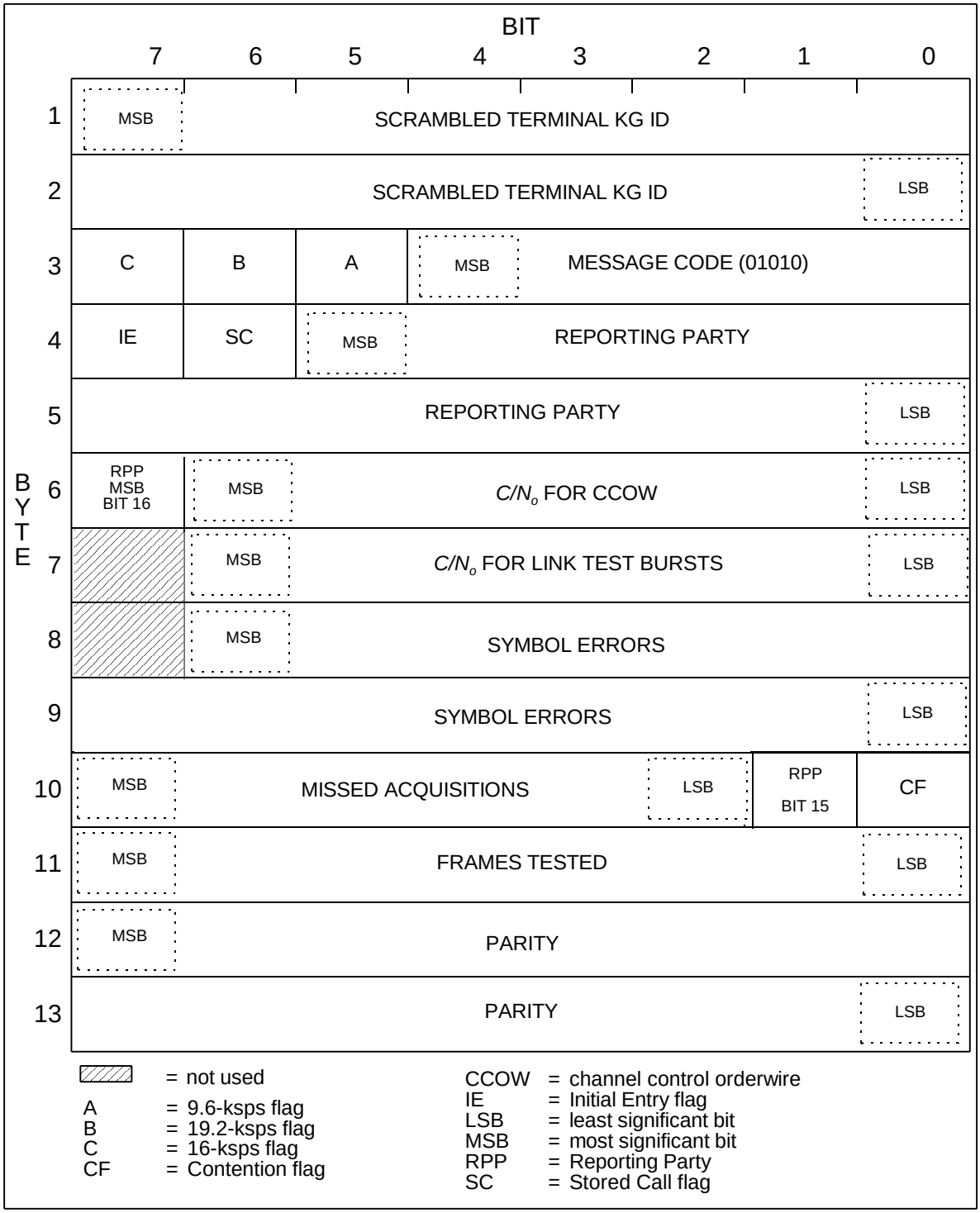

FIGURE C-11. RCCOW: C/N_o and Link Test Results.

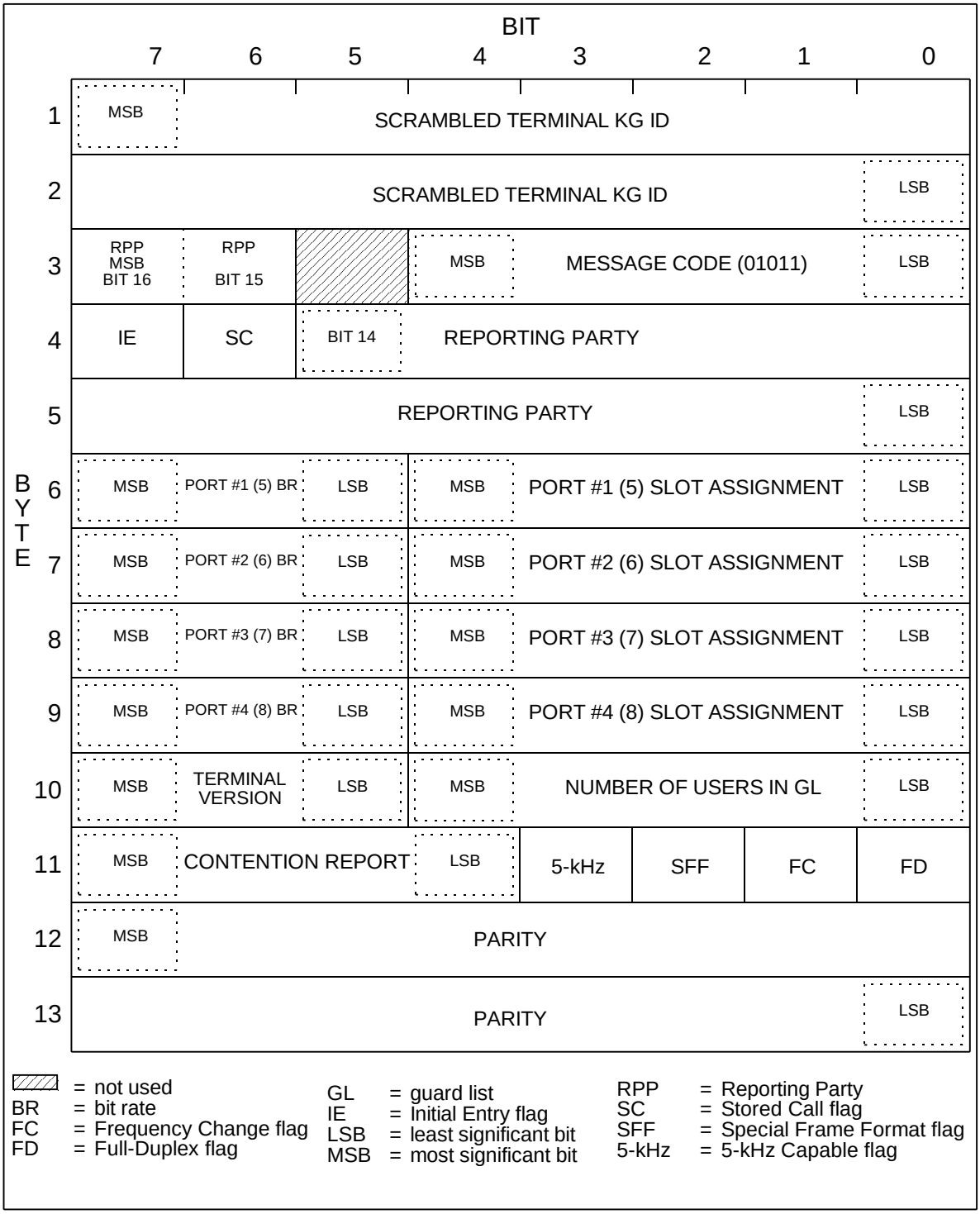

FIGURE C-12. RCCOW:Status Report A.

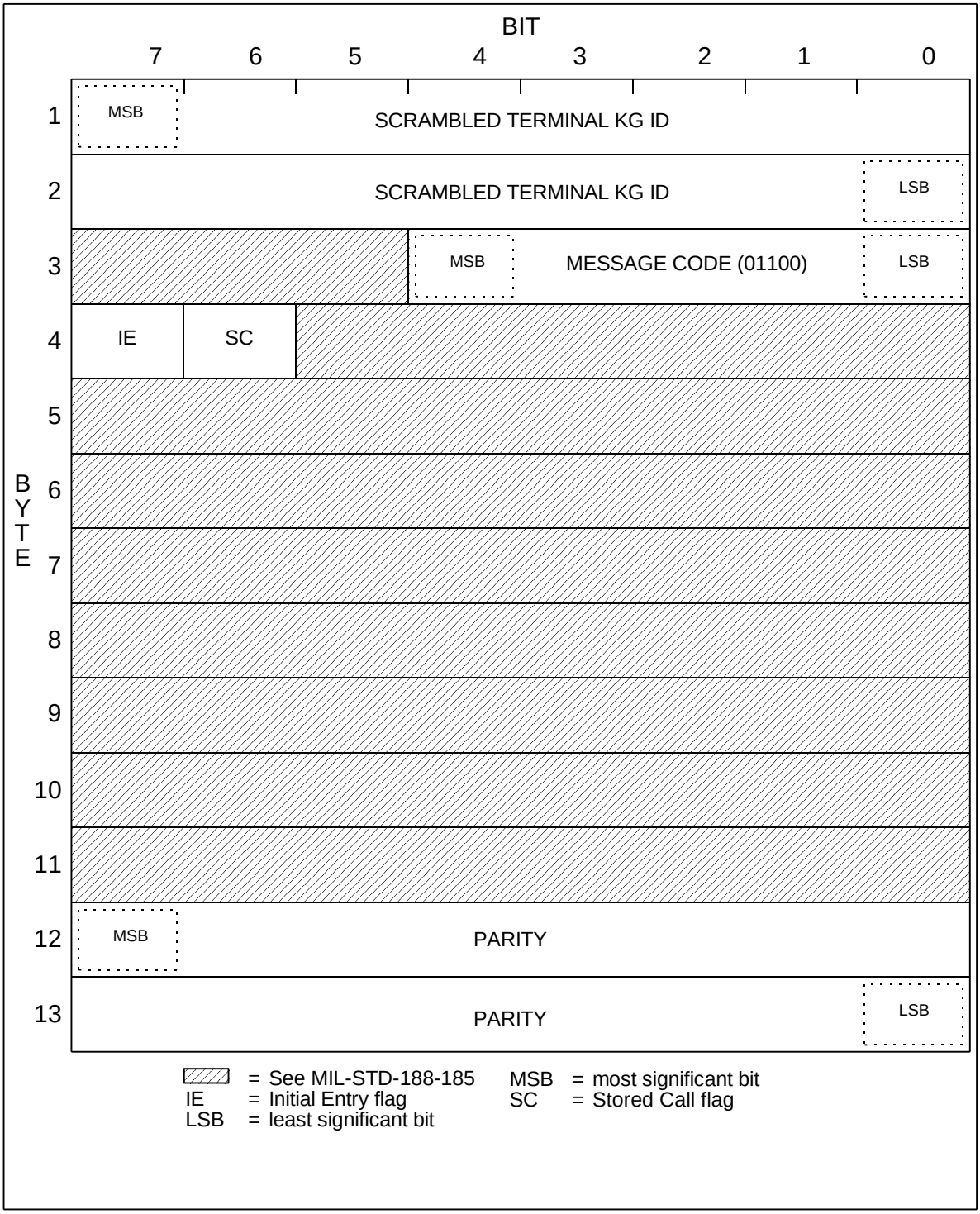

FIGURE C-13. RCCOW:Acknowledge Channel Control Request.

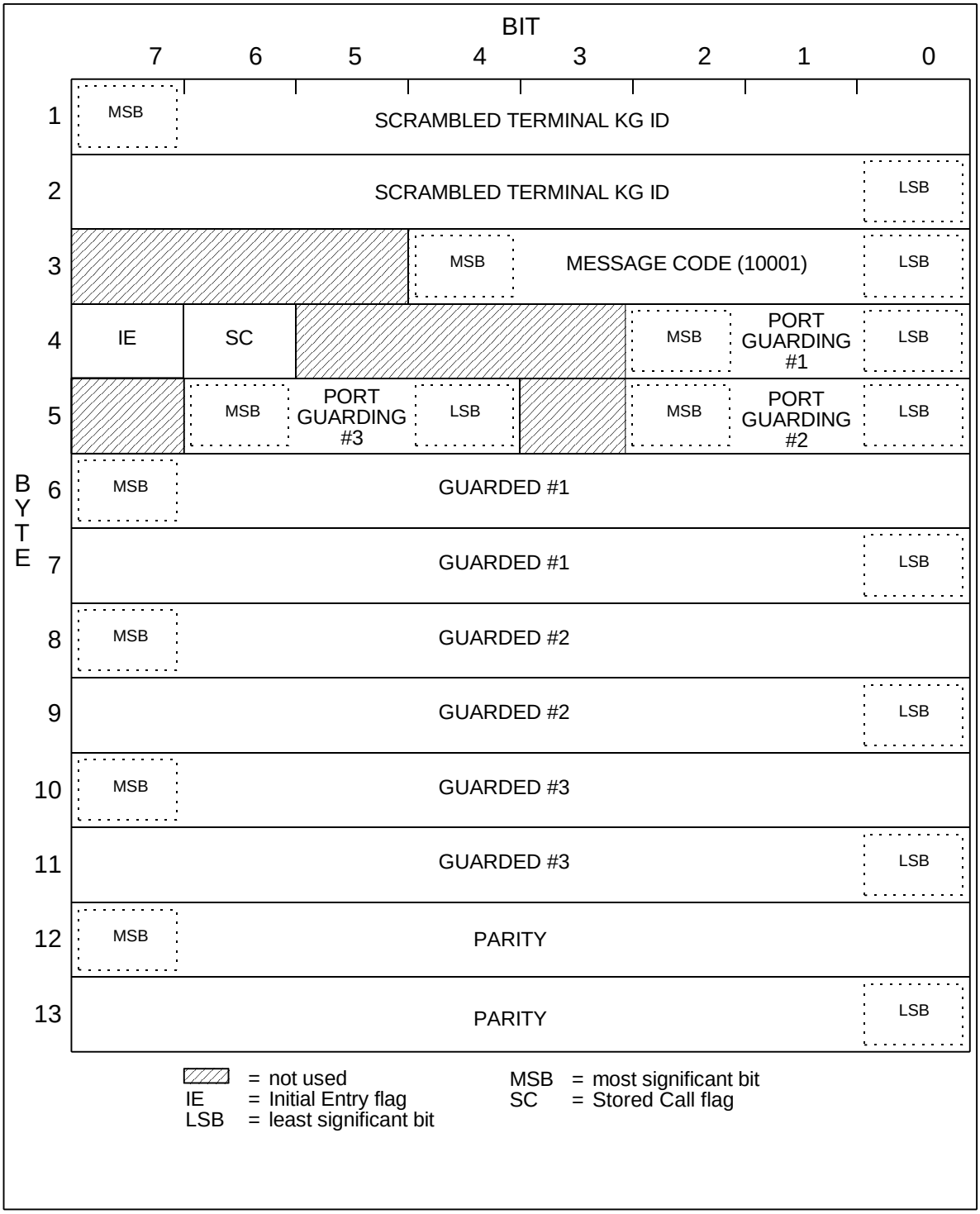

FIGURE C-14. RCCOW:Guard List Report.

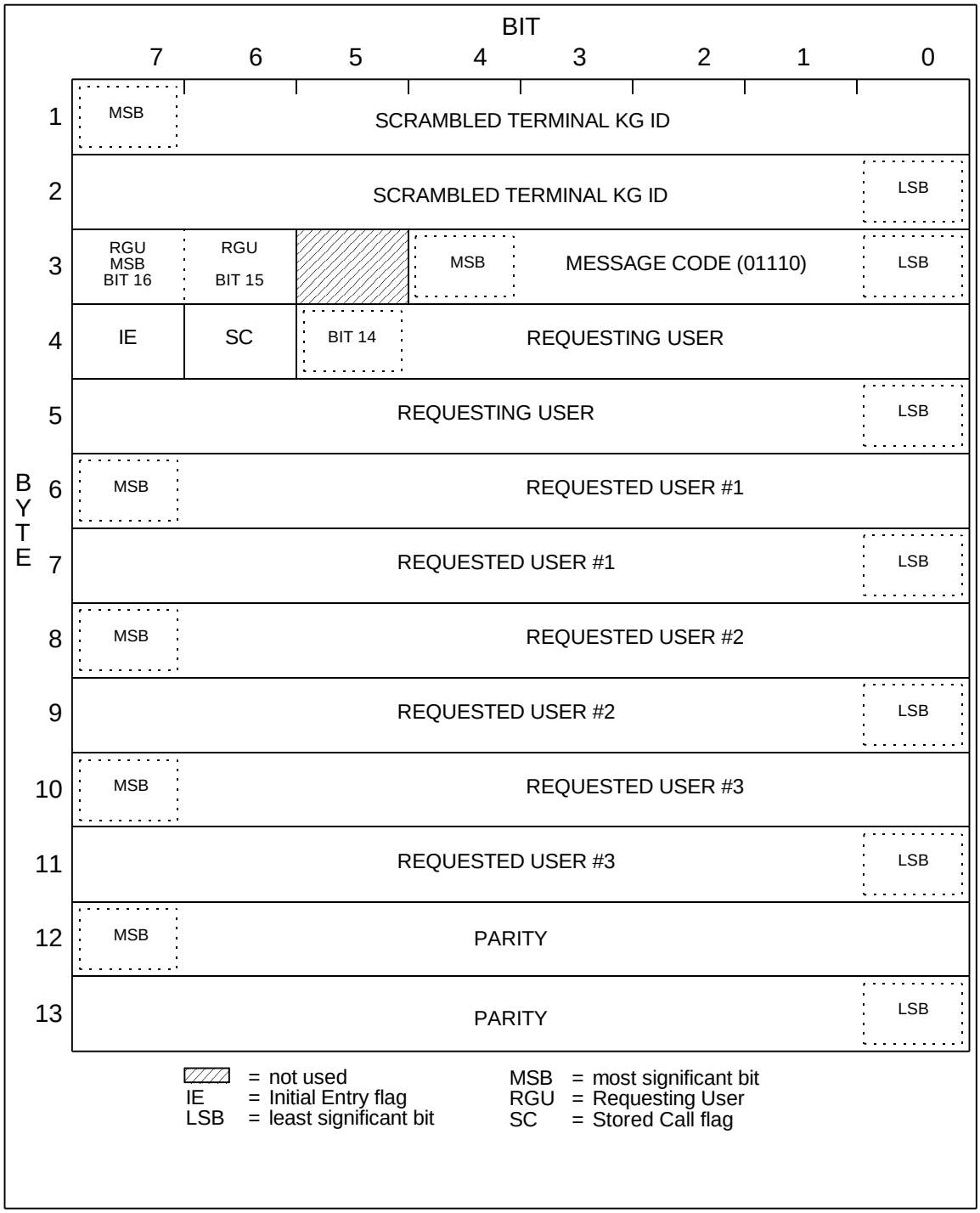

FIGURE C-15. RCCOW:Paging.

APPENDIX D

FREQUENCY PLANS

D.1 SCOPE

This Appendix is a mandatory part of this standard. The information contained herein is intended for compliance and provides the correlation between the channel frequency code and radio frequency (rf) of operation. The channel frequency codes defined herein are included in AC mode CCOW and RCCOW messages, as follows:

- CCOW:Slot Connect
- CCOW:TDMA Channel Reassignment
- CCOW:DASA Channel Assignment
- RCCOW:Call Complete

APPENDIX D

TABLE D-I. Current and UHF Follow-On frequency plans.
(This table will be used for the Channel Frequency fields.
See key at end of table.)

CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
0	0	NONE	NONE	NONE	N/A	
1	1	SHF	250.350	W1	N1	Fleet broadcast
2	2	SHF	250.400		N'1	"
3	3	SHF	250.450	A1	O1	"
4	4	SHF	250.500		O'1	"
5	5	SHF	250.550	B1	P1	"
6	6	SHF	250.600		P'1	"
7	7	SHF	250.650	C1	Q1	"
8	8	SHF	250.700		Q'1	"
9	9	292.850	251.850	W3	N2	NAVY 25kHz CHANNELS, 41 MHz OFFSET
10	0A	292.950	251.950	A2	O2	"
11	0B	293.050	252.050	B2	P2	"
12	0C	293.150	252.150	C2	Q2	"
13	0D	294.550	253.550	W4	N3	"
14	0	294.650	253.650	A3	O3	"
15	0F	294.750	253.750	B3	P3	"
16	10	294.850	253.850	C3	Q3	"
17	11	296.250	255.250	W5	N4	"
18	12	296.350	255.350	A4	O4	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
19	13	296.450	255.450	B4	P4	NAVY 25kHz CHANNELS, 41 MHz OFFSET
20	14	296.550	255.550	C4	Q4	"
21	15	297.850	256.850	W6	N5	"
22	16	297.950	256.950	A5	O5	"
23	17	298.050	257.050	B5	P5	"
24	18	298.150	257.150	C5	Q5	"
25	19	299.350	258.350	W7	N6	"
26	1A	299.450	258.450	A6	O6	"
27	1B	299.550	258.550	B6	P6	"
28	1C	299.650	258.650	C6	Q6	"
29	1D	306.250	265.250	W8	N7	"
30	1E	306.350	265.350	A7	O7	"
31	1F	306.450	265.450	B7	P7	"
32	20	306.550	265.550	C7	Q7	"
33	21	307.750	266.750	*	N8	"
34	22	307.850	266.850	A8	O8	"
35	23	307.950	266.950	B8	P8	"
36	24	308.050	267.050	C8	Q8	"
37	25	309.150	268.150		N9	"
38	26	309.250	268.250	A9	O9	"
39	27	309.350	268.350	B9	P9	"

* 307.750 was used as the Gapfiller channel A uplink frequency. 266.750 is not in correct use as a downlink frequency.

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
40	28	309.450	268.450	C9	Q9	NAVY 25KHz CHANNELS, 41 MHz OFFSET
41	29	310.650	269.650		N10	"
42	2A	310.750	269.750	A10	O10	"
42	2A	310.750	269.750	A10	O10	"
43	2B	310.850	269.8 0	B10	P10	"
44	2C	310.950	269.950	C10	Q10	"
45	2D	293.950	260.350	A23-1		DoD 500 kHz CHANNELS/ UFO 25kHz CHANNELS
46	2E	293.975	260.375	A23-2	N11	"
47	2F	294.000	260.400	A23-3		"
48	30	294.025	260.425	A23-4	P11	"
49	31	294.050	260.450	A23-5		"
50	32	294.075	260.475	A23-6	N12	"
51	33	294.100	260.500	A23-7		"
52	34	294.125	260.525	A23-8	P12	"
53	35	294.150	260.550	A23-9		"
54	36	294.175	260.575	A23-10	O11	"
55	37	294.200	260.600	A23-11		"
56	38	294.225	260.625	A23-12	Q11	"
57	39	294.250	260.650	A23-13		"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
58	3A	294.275	260.675	A23-14	012	DoD 500 kHz CHANNELS/ UFO 25kHz CHANNELS
59	3B	294.300	260.700	A23-15		"
60	3C	294.325	260.725	A23-16	Q12	"
61	3D	294.350	260.750	A23-17		"
62	3E	294.375	260.775	A23-18		"
63	3F	294.400	260.800	A23-19		"
64	40	294.425	260.825	A23-20		"
65	41	294.450	260.850	A23-21		"
66	42	295.050	261.450	B23-1		"
67	43	295.075	261.475	B23-2		"
68	44	295.100	261.500	B23-3		"
69	45	295.125	261.525	B23-4		"
70	46	295.150	261.550	B23-5		"
71	47	295.175	261.575	B23-6	N13	"
72	48	295.200	261.600	B23-7		"
73	49	295.225	261.625	B23-8	P13	"
74	4A	295.250	261.650	B23-9		"
75	4B	295.275	261.675	B23-10	N14	"
76	4C	295.300	261.700	B23-11		"
77	4D	295.325	261.725	B23-12	P14	"
78	4E	295.350	261.750	B23-13		"
79	4F	295.375	261.775	B23-14	N15	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
80	50	295.400	261.800	B23-15		DoD 500 kHz CHANNELS/ UFO 25kHz CHANNELS
81	51	295.425	261.825	B23-16	P15	"
82	52	295.450	261.850	B23-17		"
83	53	295.475	261.875	B23-18	N16	"
84	54	295.500	261.900	B23-19		"
85	55	295.525	261.925	B23-20	P16	"
86	56	295.550	261.950	B23-21		"
87	57	295.650	262.050	C23-1		"
88	58	295.675	262.075	C23-2	O13	"
89	59	295.700	262.100	C23-3		"
90	5A	295.725	262.125	C23-4	Q13	"
91	5B	295.750	262.150	C23-5		"
92	5C	295.775	262.175	C23-6	O14	"
93	5D	295.800	262.200	C23-7		"
94	5E	295.825	262.225	C23-8	Q14	"
95	5F	295.850	262.250	C23-9		"
96	60	295.875	262.275	C23-10	O15	"
97	61	295.900	262.300	C23-11		"
98	62	295.925	262.325	C23-12	Q15	"
99	63	295.950	262.350	C23-13		"
100	64	295.975	262.375	C23-14	O16	"
101	65	296.000	262.400	C23-15		"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
102	66	296.025	262.425	C23-16	Q16	DoD 500 kHz CHANNELS/ UFO 25kHz CHANNELS
103	67	296.050	262.450	C23-17		"
104	68	296.075	262.475	C23-18		"
105	69	296.100	262.500	C23-19		"
106	6A	296.125	262.525	C23-20		"
107	6B	296.150	262.550	C23-21		"
108	6C	297.150	263.550	W2-1		"
109	6D	297.175	263.575	W2-2	N17	"
110	6E	297.200	263.600	W2-3		"
111	6F	297.225	263.625	W2-4	P17	"
112	70	297.250	263.650	W2-5		"
113	71	297.275	263.675	W2-6	N18	"
114	72	297.300	263.700	W2-7		"
115	73	297.325	263.725	W2-8	P18	"
116	74	297.350	263.750	W2-9		"
117	75	297.375	263.775	W2-10	O17	"
118	76	297.400	263.800	W2-11		"
119	77	297.425	263.825	W2-12	Q17	"
120	78	297.450	263.850	W2-13		"
121	79	297.475	263.875	W2-14	O18	"
122	7A	297.500	263.900	W2-15		"
123	7B	297.525	263.925	W2-16	Q18	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
124	7C	297.550	263.950	W2-17		DoD 500 kHz CHANNELS/ UFO 25kHz CHANNELS
125	7D	297.575	263.975	W2-18		"
126	7E	297.600	264.000	W2-19		"
127	7F	297.625	264.025	W2-20		"
128	80	297.650	264.050	W2-21		"
129	81	302.445	248.845		N27	GAPFILLER 500 kHz CHANNELS/ UFO 5 kHz CHANNELS
130	82	302.450	248.850	G1		"
131	83	302.455	248.855		N28	"
132	84	302.465	248.865		N29	"
133	85	302.475	248.875	G2	N30	"
134	86	302.485	248.885		N31	"
135	87	302.495	248.895		N32	"
136	88	302.500	248.900	G3		"
137	89	302.505	248.905		N33	"
138	8A	302.515	248.915		N34	"
139	8B	302.525	248.925	G4	N35	"
140	8C	302.535	248.935		N36	"
141	8D	302.545	248.945		N37	"
142	8E	302.550	248.950	G5		"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
143	8F	302.555	248.955		N38	GAPFILLER 500 kHz CHANNELS/ UFO 5 kHz CHANNELS
144	90	302.565	248.965		N39	"
145	91	302.575	248.975	G6	O27	"
146	92	302.585	248.985		O28	"
147	93	302.595	248.995		O29	"
148	94	302.600	249.000	G7		"
149	95	302.605	249.005		O30	"
150	96	302.615	249.015		O31	"
151	97	302.625	249.025	G8	O32	"
152	98	302.635	249.035		O33	"
153	99	302.645	249.045		O34	"
154	9A	302.650	249.050	G9		"
155	9B	302.655	249.055		O35	"
156	9C	302.665	249.065		O36	"
157	9D	302.675	249.075	G10	O37	"
158	9E	302.685	249.085		O38	"
159	9F	302.695	249.095		O39	"
160	A0	302.700	249.100	G11		"
161	A1	302.705	249.105		P27	"
162	A2	302.715	249.115		P28	"
163	A3	302.725	249.125	G12	P29	"
164	A4	302.735	249.135		P30	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
165	A5	302.745	249.145		P31	GAPFILLER 500 kHz CHANNELS/ UFO 5 kHz CHANNELS
166	A6	302.750	249.150	G13		"
167	A7	302.755	249.155		P32	"
168	A8	302.765	249.165		P33	"
169	A9	302.775	249.175	G14	P34	"
170	AA	302.785	249.185		P35	"
171	AB	302.795	249.195		P36	"
172	AC	302.800	249.200	G15		"
173	AD	302.805	249.205		P37	"
174	AE	302.815	249.215		P38	"
175	AF	302.825	249.225	G16	P39	"
176	BO	302.835	249.235		Q27	"
177	B1	302.845	249.245		Q28	"
178	B2	302.850	249.250	G17		"
179	B3	302.855	249.255		Q29	"
180	B4	302.865	249.265		Q30	"
181	B5	302.875	249.275	G18	Q31	"
182	B6	302.885	249.285		Q32	"
183	B7	302.895	249.295		Q33	"
184	B8	302.900	249.300	G19		"
185	B9	302.905	249.305		Q34	"
186	BA	302.915	249.315		Q35	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
187	BB	302.925	249.325	G20	Q36	GAPFILLER 500 kHz CHANNELS/ UFO 5 kHz CHANNELS
188	BC	302.935	249.335		Q37	"
189	BD	302.945	249.345		Q38	"
190	BE	302.950	249.350			"
191	BF	302.955	249.355		Q39	"
192	CO	307.750	254.150	GA		GAPFILLER 25 kHz (UFO CHAN N8 UPLINK)
193	C1	311.150	257.550	GB		GAPFILLER 25 kHz
194	C2	316.955	243.855	W9		AFSAT/ LEASAT NON-PROC. 5 kHz REPLACE-MENT CHANNELS
195	C3	316.960	243.860	W10		"
196	C4	316.975	243.875	W11		"
197	C5	317.000	243.900	W12		"
198	C6	317.010	243.910	W13		"
199	C7	317.015	243.915		N19	"
200	C8	317.025	243.925		N20	"
201	C9	317.035	243.935		N21	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
202	CA	317.045	243.945	A11	N22	AFSAT/ LEASAT NON-PROC. 5 kHz REPLACE-MENT CHANNELS
203	CB	317.055	243.955	A12	N23	"
204	CC	317.065	243.965	A14	N24	"
205	CD	317.075	243.975	A16	N25	"
206	CE	317.085	243.985	A18	N26	"
207	CF	317.090	243.990	A19		"
208	DO	317.095	243.995	A20	O19	"
209	D1	317.100	244.000	A21		"
210	D2	317.105	244.005		O20	"
211	D3	317.110	244.010	A22		"
212	D4	317.115	244.015		O21	"
213	D5	317.125	244.025		O22	"
214	D6	317.135	244.035		O23	"
215	D7	317.145	244.045	B11	O24	"
216	D8	317.155	244.055	B12	O25	"
217	D9	317.165	244.065	B14	O26	"
218	DA	317.175	244.075	B16	P19	"
219	DB	317.185	244.085	B18	P20	"
220	DC	317.190	244.090	B19		"
221	DD	317.195	244.095	B20	P21	"

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
222	DE	317.200	244.100	B21		AFSAT/ LEASAT NON-PROC. 5 kHz REPLACE-MENT CHANNELS
223	DF	317.205	244.105		P22	"
224	EO	317.210	244.110	B22		"
225	E1	317.215	244.115		P23	"
226	E2	317.225	244.125		P24	"
227	E3	317.235	244.135		P25	"
228	E4	317.245	244.145	C11	P26	"
229	E5	317.255	244.155	C12	Q19	"
230	E6	317.265	244.165	C14	Q20	"
231	E7	317.275	244.175	C16	Q21	"
232	E8	317.285	244.185	C18	Q22	"
233	E9	317.290	244.190	C19		"
234	EA	317.295	244.195	C20	Q23	"
235	EB	317.300	244.200	C21		"
236	EC	317.305	244.205		Q24	"
237	ED	317.310	244.210	C22		"
238	EE	317.315	244.215		Q25	"
239	EF	317.325	244.225		Q26	"
240	FO	307.550	253.950		NATO IVB/ SKYNET 4A	25KhZ/ 25kHz (UK)
241	F1	307.700	254.100		NATO IVA	25kHz

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CHANNEL NUMBER		UPLINK FREQUENCY (MHz)	DOWNLINK FREQUENCY (MHz)	PRESENT CHANNEL	UFO CHANNEL	NOTES
DECIMAL	HEX					
242	F2	311.050	257.450		NATO IVB/ SKYNET 4A	25KhZ/ 25kHz (UK)
243	F3	311.200	257.600		NATO IVA	25kHz
244	F4	307.750	254.150		SKYNET 4B	25kHz (UK)
245	F5	311.250	257.650		SKYNET 4B	25kHz (UK)
246	F6	307.650	254.050		SKYNET 4C	25kHz (UK)
247	F7	311.150	257.550		SKYNET 4C	25kHz (UK)
248	F8	294.800 to 314.800	253.650 to 254.350		SKYNET 4D	** 25kHz (UK)
249	F9	298.300 to 318.300	257.150 to 257.850		SKYNET 4D	** 25kHz (UK)
250	FA					
251	FB					
252	FC					
253	FD					
254	FE					
255	FF					

** The uplink and downlink frequencies associated with these channel frequency codes should be front panel programmable in 25-kHz increments over the frequency ranges shown.

Key to channel numbers: Table D-I lists several plans used on UHF satellites for DoD. Fleet satellite communications (FLTSATCOM) satellites use frequency plans *A*, *B*, and *C*. Leased Satellites (LEASATs) use frequency plans *X*, *Y*, and *Z*, which are abbreviated versions of plans *A*, *B*, and *C* (LEASATs have fewer channels). In addition, LEASAT has plan W, which shares frequencies with Air Force satellite communications (AFSATCOM) polar frequency plan *E*. Gapfiller has been labeled for this table as *G*. UHF Follow-On (UFO) uses four frequency plans, *N*, *O*, *P*, and *Q*. In addition,

there are alternate fleet broadcast downlink frequencies labeled *N'*, *O'*, *P'*, and *Q'*.

Table D-I lists *present Channel* and *UFO Channel* as follows: Frequency plan, transponder number, and an optional transponder subdivision. As an example, Channel Number 46 (Hex 2E) is A23-2. This corresponds to FLTSATCOM frequency plan *A*, a DoD 500-kHz wideband channel (used as a 25-kHz subchannel) which is being replaced by UFO 25-kHz channel N11 (frequency plan *N*, transponder 11).

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APPENDIX E

DERIVATION OF FREQUENCY ACCURACY VALUES

E.1 SCOPE

This appendix is not a mandatory part of the standard. The information contained herein is intended for guidance only. The appendix provides one possible derivation of the frequency accuracy values specified in 5.6.1 and 5.6.2.

E.2 ASSUMPTIONS

The assumptions used to derive these values originate from a number of studies performed by the Services and industry. Review of these studies permitted convergence to a nearly worst-case set of assumptions. Worst-case assumptions were not used in all cases to derive the frequency accuracy values. However, the assumptions for new-design equipment were reviewed and chosen to allow operation under nearly all circumstances. The 13 assumptions are:

! The satellite inclination angle A_i equals ± 10 degrees, corresponding to a maximum satellite velocity of 80.5 meters per second in the direction of a controller or terminal located at worst-case latitude.

! The maximum frequency translation error of the satellite transponder is 5 Hz.

! The accuracy of the terminal's reference frequency is 3.0×10^{-8} or better.

! The accuracy of the controller's reference frequency is 5×10^{-8} or better.

! The frequency error caused by satellite eccentricity is negligible.

! The maximum uplink satellite frequency (F_{UL}) is 311 MHz and the maximum downlink satellite frequency (F_{DL}) is 270 MHz.

! The controller and the terminals may be located at latitudes of up to 70 degrees.

! The controller may have a maximum velocity of 55 knots (28.3 meters per second).

! The terminal may have a maximum velocity of 800 knots (412 meters per second).

- The terminal's maximum Doppler rate of change is 32 Hz/sec^2.

- The controller's maximum Doppler rate of change is negligible.

- The frequency measurement error of either the controller or the terminal is 20 Hz.

- The frequency setting error of either the controller or the terminal is 2.3 Hz.

E.3 ERROR CALCULATION PROCEDURE

This appendix uses a procedure described in a paper prepared for IEEE TCC-90 by Dr. Edward W. Chandler, Ph.D, *A Frequency Tracking Technique for Multiple Access Satellite Communication Networks*. By using the procedure in conjunction with the above assumptions, the terminal's uplink and downlink frequency errors are calculated. These errors represent one set of conditions that result in the specified frequency accuracy values. The procedure used to determine these errors is based on frequency measurements on one type of burst, i.e., orderwire bursts from the controller. More elaborate techniques could be used to produce smaller frequency errors or to produce errors within these same limits under conditions that are worse than those stated in the above assumptions.

E.4 CONTROLLER UPLINK ERROR CALCULATION

To obtain the uplink and downlink frequency accuracies for a terminal, it is necessary to first determine the controller's uplink error. It is assumed the controller is using a frequency tracking technique that limits its uplink error at the satellite output to 30 Hz, as stated in 5.6.1 a. Derivation of this value will be shown. Uplink error includes errors from all sources, including the satellite transmitter and satellite translation error. Since frequency differences caused by satellite inclination angle and by the controller's latitude and velocity are compensated for by the controller, the tracking computation used by the terminal is independent of the frequency differences caused by these sources. For the controller a table of observable, and therefore correctable, errors can be constructed. Table E-I depicts these errors and is similar to Table VI in the TCC-90 paper.

In Table E-I, $^{a}F_{OBS,i(max)}$ is the maximum frequency offset that can be observed for the i-th source, and $CF_{UL,i}$ is the uplink

correction factor for the *i*-th source. By reducing and reordering this table, similar to the manner in which Table VI is reduced to Table VII in the TCC-90 paper, the optimum uplink correction factor can be determined using the procedure described in that paper. The table is reduced by combining those offset sources with identical correction factors, and reordered by listing the sources in order of smallest to largest correction factor, as shown in Table E-II.

TABLE E-I. Controller frequency errors.

ROW	OFFSET SOURCE	$)F_{OBS,\ i\ (max)}$ (Hz)	$CF_{UL,i}$
1	Satellite to controller motion	210.7 (1)	$-F_{UL}/(F_{UL} + F_{DL})$
2	Satellite translation error	5.0	-1
3	Controller frequency error	2.3	0
4	Controller reference frequency error	2.1 (2)	$-F_{UL}/(F_{UL} - F_{DL})$
5	Controller frequency measurement error	20.0	0

Notes:

(1) Maximum satellite (SAT) velocity is considered to be 80.5 meters per second, as determined by an approximation for operation at 70 degrees latitude. The maximum controller velocity is 28.3 meters per second. The frequency contribution from satellite motion relative to the controller is

$$[(80.5 + 28.3)/(3.0 \times 10^8)][(311 + 270) \times 10^6] = 210.7 \text{ Hz}$$

(2) The controller's receiver and transmitter share the same reference frequency source. The error is

$$(311 - 270) \times 10^6 \times (5.0 \times 10^{-8}) = 2.1 \text{ Hz}.$$

TABLE E-II. Controller uplink errors (reduced table).

i	CONTRIBUTING ROW NUMBERS	$)F_{OBS,\ i\ (max)}$ (Hz)	$CF_{UL,i}$
1	4	2.1	$-F_{UL} / (F_{UL} - F_{DL}) = -7.585$
2	2	5.0	-1
3	1	210.7	$-F_{UL} / (F_{UL} + F_{DL}) = -0.535$
4	3 and 5	22.3	0

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The optimum correction factor CF_{UL} is for i = 3, since that is the row farthest down the table where the sum of all maximum offsets in all rows beneath and including that row is greater than the sum of all maximum offsets in all rows above that row. This correction factor may then be used in equation 5 from the TCC-90 paper, repeated here for convenience, to determine the controller's maximum uplink error.

Using the equation

$$*E_{UL}*_{max} \; ' \; \sum_{i'1}^{N_{UL}} [*CF_{UL} \; \& \; CF_{UL,i}*()F_{OBS,i(max)})] \qquad \text{(E-1)}$$

$$*E_{UL}\,*_{max} = *\text{-}0.535 - (\text{-}7.585)*(2.1) + *\text{-}0.535 - (\text{-}1)*(5) + *\text{-}0.535 - 0*(22.3) = 29.1 \text{ Hz}$$

This value has been rounded up to 30 Hz for the standard's controller value stated in 5.6.1 a.

E.5 TERMINAL UPLINK AND DOWNLINK FREQUENCY ERRORS

The same procedure is used to analyze the uplink and downlink errors for the terminal. It is assumed the terminal has achieved initial frame acquisition and that burst-to-burst frequency tracking is being performed by the terminal. To determine the terminal's uplink and downlink errors, a table similar to Table IX in the TCC-90 paper is created. Table E-III shows the results.

TABLE E-III. Terminal frequency errors.

ROW	OFFSET SOURCE	$)F_{OBS,i(max)}$ (Hz)	$CF_{UL,i}$	$CF_{DL,i}$
1	Controller uplink error	30.0 (1)	0	0
2	Terminal frequency measurement error	20.0	0	0
3	Satellite motion toward terminal	72.5 (2)	$-f_{UL} / f_{DL}$	1
4	Terminal motion toward satellite	370.8 (3)	$-f_{UL} / f_{DL}$	1
5	Terminal reference frequency error	8.1 (4)	f_{UL} / f_{DL}	1
6	Terminal acceleration (over 1 frame)	20.6 (5)	0	0

Notes:

(1) 30 Hz represents the assumed worst-case controller uplink offset.

(2) The frequency contribution from satellite motion, assuming A_i = 10, is $(8.05/3.0 \times 10^8)(A_i)(270.0 \times 10^6)$ = 72.5 Hz

(3) The frequency contribution from the terminal's motion is $(412/3.0 \times 10^8)(270.0 \times 10^6)$ = 370.8 Hz

(4) The terminal's reference frequency error is its specified accuracy of 3.0×10^{-8} multiplied by the maximum receive frequency of 270 MHz.

(5) The frequency contribution from the terminal's doppler acceleration in a period of one frame is 32 Hz/sec^2 multiplied by the proportion allocated to receive (270/(270 + 311)) multiplied by the frame length of 1.386 seconds.

Reducing and reordering this table for the terminal's uplink error calculation yields results shown in Table E-IV.

TABLE E-IV. Terminal uplink errors (reduced table).

i	CONTRIBUTING ROW NUMBERS	$)F_{OBS,\ i(max)}$ (Hz)	$CF_{UL,\ i}$
1	3 and 4	443.3	$-F_{UL}\ /\ F_{DL}$ = - 1.152
2	1, 2, and 6	70.6	0
3	5	8.1	$F_{UL}\ /\ F_{DL}$ = 1.152

Here, the optimum correction factor is for *i* equal to 1. Solving equation 5 from the TCC-90 paper yields:

$$*E_{UL}*_{max} = *-1.152 - 0*(70.6) + *-1.152 - 1.152 *(8.1)$$

$$= 100.0 \text{ Hz}$$

The terminal’s worst-case uplink frequency accuracy is 100.0 Hz and is equal to the standard’s terminal uplink frequency accuracy value specified in 5.6.1.

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Reducing and reordering the table for the terminal's downlink frequency error yields results shown in Table E-V.

TABLE E-V. Terminal downlink errors (reduced table).

i	CONTRIBUTING ROW NUMBERS	$)F_{OBS,\ i(max)}$ (Hz)	$CF_{DL,\ i}$
1	1, 2, and 6	70.6	0
2	3, 4, and 5	451.4	1

Here, the optimum correction factor is for i = 2. Equation 6 from the TCC-90 paper is identical to equation 5, except for replacement of *UL* subscripts with *DL*. Using equation 6 from the TCC-90 paper yields

$$*E_{DL}*_{max} = *1 - 0*(70.6)$$

$$= 70.6 \text{ Hz}$$

To obtain the total downlink frequency accuracy requirement for the terminal, consider the case of a different type terminal transmitting with a frequency error of up to 240 Hz. In this situation the transmitting terminal is not compliant with 5.6.1 herein, but is compliant with the requirements of 5.6.1 in MIL-STD-188-183 dated 18 September 1992. Since the receiving terminal's own downlink may also be in error by as much as 70.6 Hz, the total downlink frequency accuracy required by a receiving terminal is the sum of these values, or 310.6 Hz. This value is approximated as 310 Hz and specified as such in 5.6.2.

CONCLUDING MATERIAL

Custodians:

Army - CR
Navy - EC
Air Force - 90

Preparing Activity:

DISA - DC1
(Project TCSS-1831)

Review Activities:

Army - AC, IE, IQ, IR, SC, PT
Navy - CG, MC, OM, NC, TD
Air Force - 02, 13, 17, 21, 29, 33, 93
DLA - DH
NSA - NS
DMA - MP

Civil Agency Coordinating Activities:

DOT - OST

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER: **MIL-STD-188-183A**	2. DOCUMENT DATE (YYMMDD) **980320**

3. DOCUMENT TITLE: **Interoperability Standard for 25-kHz UHF TDMA/DAMA Terminal Waveform**

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(if applicable)*	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME: **Joint Interoperability and Engineering Organization (JIEO)**	b. TELEPHONE *(Include Area Code)* (1) Commercial: **(732) 427-6865** (2) AUTOVON: **987-6865**
c. ADDRESS *(Include Zip Code)* **ATTN: JEBBC** **Fort Monmouth, NJ 07703-5613**	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340